# THE DENTAL PRACTITIONER

## AND DENTAL RECORD

*Including the Transactions of the British Society for the Study of Orthodontics, and the official reports of the British Society of Periodontology, the Glasgow Odontological Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis*



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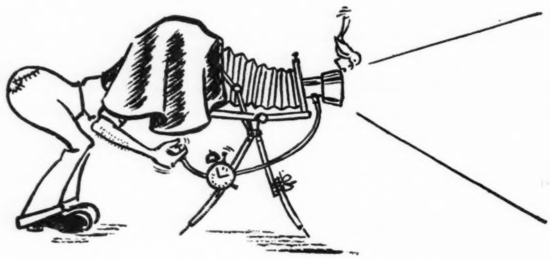





# THE DENTAL PRACTITIONER
## AND DENTAL RECORD

*Vol.* IX, *No.* 3 | *November*, 1958

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# THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. IX, No. 3 November, 1958


*EDITORIAL*

## NEW DENTAL SCHOOLS

In his presidential address to the General Dental Council, Sir Wilfred Fish stated that "The fact that the number [of dentists] is going down instead of up emphasizes the urgent need for the recommendation of the McNair Committee to be implemented". The address called forth a leader in *The Times*, and the words of the President were given the widest publicity, which they correctly deserved. In January of this year our Editorial was devoted to this problem, and indeed went as far as to say that "Unless some positive step is taken and a definite policy decided in 1958, there is a danger that the present position of dental treatment will degenerate into a condition of national urgency". We believe that these words were true then and that they still apply to the situation.

The Government announced that they accepted the McNair Report in July, 1958, but we still await their proposals. The recent announcement on capital investment leads us to hope that a part of this money is ear-marked for expansion of the dental schools. However, we have to await the Chancellor's final decision, but there is still another month in 1958 before the sands of time run out. We believe that the Government is now prepared to implement the recommendation of the McNair Report and we hope that their proposals will not be niggardly.

It has taken a long time, but we trust that the road is now clear and that the Government will give the green light for the improvement of dental education. New buildings are of course not enough. A school's reputation depends upon its staff, not on its architectural features, although they undoubtedly help to attract a better staff. An increase in facilities for teaching more dental students demands more teaching staff, although not in the same ratio. There is also the question of obtaining more dental house surgeons and registrars which is related to the problems of larger dental schools. Many of these problems are one of finance and are being considered by the Royal Commission on Doctors' and Dentists' Remuneration. Their report has not yet been produced, but in the meantime let us hope that plans will start on new buildings and that the future of dentistry will be assured.

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# SILICONE IMPRESSION MATERIALS*

## A RESEARCH REPORT

By **JOHN W. McLEAN,** L.D.S. R.C.S. (Eng.)

*Department of Conservative Dentistry, Institute of Dental Surgery, Eastman Dental Hospital*

ALGINATES are still the most widely used elastic impression materials to-day. They do, however, possess certain defects: firstly, their dimensional instability due to water loss can cause considerable inaccuracies, and, secondly, their elasticity leaves a lot to be desired. From a practical standpoint we require an elastic impression material that will remain stable during storage periods of a week or more and also be capable of having more than one stone cast made from it. With the advent of Thiokol rubbers, and more recently the silicone elastomers, these ideals have been brought one step nearer.

The silicone oils and resins have been used in industry on an increasing scale during the last ten years with particular interest shown in them by the paint and engineering industries.

The silicone group of resins, oils, and elastomers are derived basically from two elements, silicon and oxygen, in the following manner:

$$—O—Si—O—Si—O—$$

These chains of alternating silicon and oxygen atoms are termed a siloxane chain. Broadly speaking, the silicone polymers are the siloxane group of organo-silicone polymers with hydrocarbon radicals linked directly to the silicon atoms. The simplest polyorganosiloxane is methyl silicone, being composed entirely of siloxane chains with methyl groups attached to the silicon atoms. Such a structure makes fullest use of the inorganic character of the siloxane network, for it contains a minimum of organic constituent. For example, carbon and hydrogen constitute only 40·5 per cent by weight of dimethyl silicone.

$$\begin{array}{c} CH_3 \\ | \\ —Si—O— \\ | \\ CH_3 \end{array}$$

This type of difunctional unit is required to build an elastic material, ten thousand or more molecules being necessary in the chain to constitute an elastomer. These polyorganosiloxanes mixed with zinc oxide fillers form a basis for the cold-curing silicone rubbers, and, with the addition of heavy metal alkyl carboxylic acid salts with alkyl silicates as accelerators, a cold-curing rubber can be manufactured which will set in the mouth in five to ten minutes. It is difficult to obtain much information on the exact constituents of the dental silicone rubbers, but I have seen one reference to the possible composition of these materials which may prove helpful. The paste consists of a partially polymerized polydimethylsiloxane of 2300 centistokes viscosity mixed in equal parts with finely divided zinc oxide. The liquid activator which has to be added to the paste contains 0·75 parts of dibutyl tin dilaurate mixed with 0·25 parts of tetraethyl polysilicate to form a uniform liquid.

The materials I have tested have altered in content quite considerably over the last two years, which has increased the difficulty of our laboratory tests. On the whole, I think the manufacturers have tried to produce less viscous pastes and at the same time increase the degree of polymerization by improvements in the liquid activator.

**Materials Tested.—**

| | |
|---|---|
| Verone | Davis, Schottlander & Davis Ltd., London. |
| Silflex | Flexico Developments Ltd., London. |
| Lastic 55 | Kettenbach, Germany. |

The types of tests I used on the silicone elastomers were devised to assess their dimensional stability, setting times, accuracy of reproduction of the impression surface, tensile strength, and elastic properties.

Before giving details of these tests I would like to draw attention to one serious defect in

* A paper read before the British Society for the Study of Prosthetic Dentistry, April, 1957.

these elastomers and that is their limited shelf life. Owing to the fact that the elastomers are supplied as partially polymerized pastes, their viscosity tends to increase due to continuing polymerization, especially when exposed to air. This results in a much stiffer mix which, after periods of three months or more, makes impression-taking a very difficult job, since close adaptation to the tissues will not take place and results in creasing of the impression. Up to date I have not used any silicone material that does not show this undesirable property.

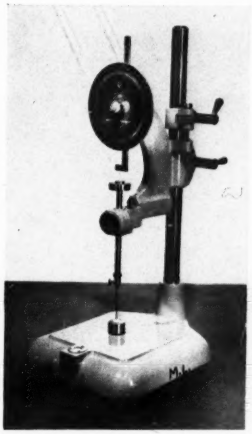

*Fig.* 1.—Penetrometer with needle in position over silicone rubber specimen.

**Setting Time.**—Owing to the fact that silicone elastomers are polymerizable materials it is difficult to use the term "setting time" with any real meaning. I find that all the silicone materials continue to polymerize for as long as two weeks after mixing, and the experiments I conducted on them with the penetrometer are really an indication of polymerization degree.

The apparatus illustrated in *Fig.* 1 was used to determine a suitable setting time for the silicone rubbers in relation to polymerization degree. The penetrometer permits the needle-holder to move in a guide without appreciable friction and is capable of indicating the depth of penetration to the nearest 0·1 mm. The total moving weight (needle, needle-holder, and superimposed weight) is 100±0·25 g.

The penetration was determined at 100° F., using the standard needle applied to the sample of rubber for 10 sec. under a load of 100 g. The needle was cleaned each time with benzene and then dried. The samples were contained in brass rings measuring 1·25 cm. in diameter and 1·9 cm. high. Each sample was tested dry and the surface was kept free from dust. A suitably placed light was used as an aid in obtaining precise adjustment of the needle so that its tip just made contact with its image on the surface of the sample.

## RESULTS

The graph (*Fig.* 2) illustrates the results of the mean average of a series of six tests that I carried out on Silflex, Verone, and Lastic 55. These were divided into two sections, the manufacturers' recommended amount of activator being used in the first section and 50 per cent excess activator being used in the second section. I allowed 3 min. for mixing and insertion of the materials into the brass rings and then commenced the time of test. The first needle penetration was taken after 3 min. of set in the rings, thus making a total of 6 min. from the start of the mix.

For a period of 10 min. after the set of the materials in the rings the graphs tend to level out, indicating that this period is probably the minimum time to attain a reasonable degree of polymerization. The 24-hour set figures show that the materials continued to polymerize, but the difference between the mean average at 10 min. of 2·6 mm. penetration and 1·6 mm. at 24 hr. indicates that the materials do not alter appreciably over this lengthy period in comparison with the changes taking place between 6 min. and 13 min. I should like to draw attention to the effect of excess activator on the silicone rubber: this results in an acceleration of the setting time by approximately 2–3 min. in the initial stages, but the end-result in all cases is the same after 24 hr.

The conclusions I drew from these experiments are that the amount of activator has a great effect on time of initial set and if a standard mix is used a minimum period of 5 min. must be allowed for these materials to set after insertion in the mouth.

**Dimensional Stability.**—In view of the claims made for silicone materials with regard to dimensional stability I was most interested to see how these materials stood up during long storage periods. It seemed to me that the simpler the test for determining dimensional stability, the greater chance one has of arriving at reasonably accurate figures. I, therefore, used a steel block measuring 10 cm. in length mounted on a steel base, the latter providing a seating guide for the perforated impression tray. The first series of impressions were taken in this tray with the perforations filled in, and an 8-min. setting time was adopted at 100° F. The tray ends were unscrewed and the strip of silicone rubber was removed (*Fig.* 3) and placed in a mercury bath underneath a travelling microscope. Measurements of the impressions were then taken after 15 min., 24 hr., 3 days, 1 week, and 2 weeks, these measurements being accurate within $\pm 0{\cdot}02$ per cent. The graph (*Fig.* 4) illustrates the dimensional changes taking place on the three materials during this storage period, the readings being the mean average of ten tests on each material. We must conclude that these

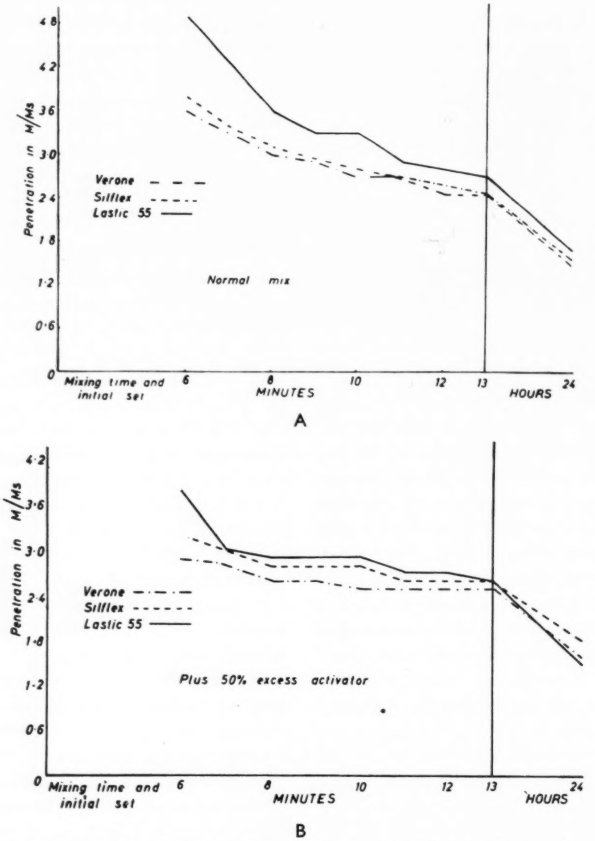


*Fig.* 2.—A, Setting times of three silicone elastomers using manufacturers' recommended amount of activators; B, Setting times of three silicone elastomers using 50 per cent excess activator.

unrestrained contraction figures do not uphold the claim that silicone elastomers are dimensionally stable during storage.

The next series of tests were designed to establish the dimensional stability of silicone

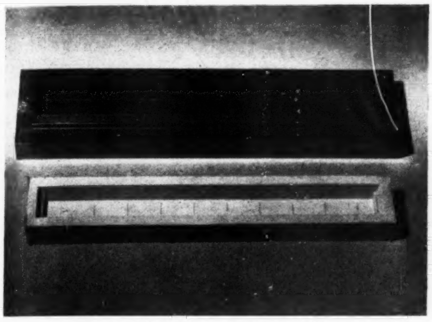

*Fig.* 3.—Ten-centimetre steel die and silicone rubber impression removed from the tray.

elastomers when held under restraint; therefore, the rubber was allowed to fill the perforations in the tray. I observed in this series that the tray exerted considerable restraint on the materials to such an effect that no significant shrinkage of the materials occurred after 48 hr. (—0·1 per cent), and that in the majority of cases a mean average figure on the plus side was obtained (+0·14 per cent).

Despite these more reassuring figures, I think that it is essential to pour our models into silicone impressions within the first hour of removal from the mouth.

**Elasticity.**—The elasticity of the silicone rubbers was determined by two tests. The first test was designed to assess the ability of the rubbers to regain their original shape after removal from a deep undercut, and the second test investigated the tension set (permanent set) of the materials.

**Dimensional Changes on the Undercut Die.**—The undercut steel die illustrated in *Fig.* 5 simulates a molar tooth and, in order to overcome suction on withdrawal of the impression, a steel pin was inserted through the centre of the die and secured to the base with a screw thread; the pin could then be removed in order to leave an air channel into the impression area. This die demanded a tensile extension of 32·8 per cent from the silicone impression material upon withdrawal.

Two series of impressions were taken. The first series were contained in a perforated steel tray, allowing a thickness of impression material of 5–6 mm., and the second series in brass rings, coated with silicone adhesive, allowing an average thickness of 3–4 mm. of impression material. Three minutes were allowed for mixing and insertion of the silicone rubbers into the rings and tray and each material was allowed to set for 5 min. in an incubator at 100° F. I then used a travelling microscope to

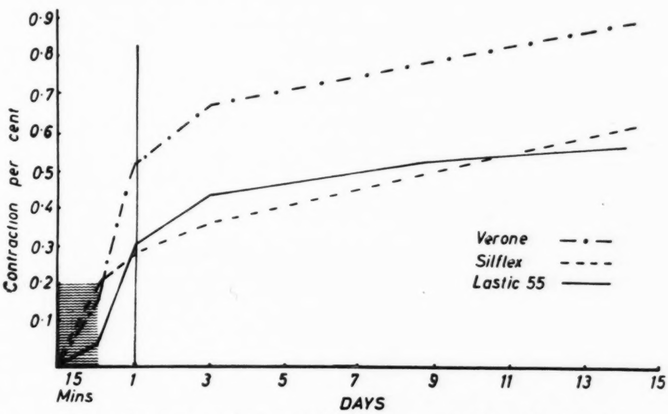


*Fig.* 4.—Dimensional changes of three unrestrained silicone elastomers.

measure the stem diameters of the impressions, which presented a knife edge where the base of the die met the steel block. These measurements could be repeated within an accuracy of $\pm 0{\cdot}02$ mm.

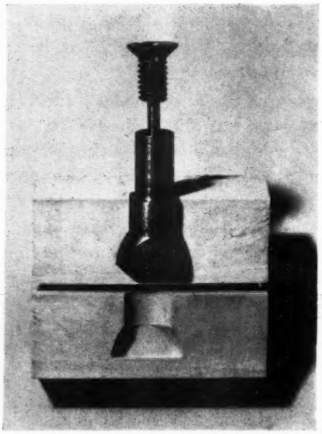

*Fig.* 5.—Silicone rubber impression sectioned in half with undercut steel die in position.

Stone models were then poured into each impression using Crystacal D (4 parts by weight to 1 part water) and the resulting stone models were then measured with the vernier calliper gauge, reading to an accuracy of 0·02 mm. It is possible to use a dial gauge micrometer allowing an error of only $\pm 0{\cdot}002$ mm., but, due to slight surface irregularities on the stone surface, such an accuracy was often masked by these differences.

*Fig.* 6 is a diagrammatic representation of the mean of six readings on Verone, Silflex, and Lastic 55. The zero line at 0·588 cm. represents the actual diameter of the stem of the master steel die and the stone diameters are represented by hatched blocks on the top of each impression material. The standard deviation of these readings is indicated for each impression material and stone model. The silicone materials held in the large tray for 48 hr. and the stone models cast into them all showed a shrinkage, whereas the models cast immediately after an 8-min. set gave readings of zero to $+0{\cdot}7$ per cent.

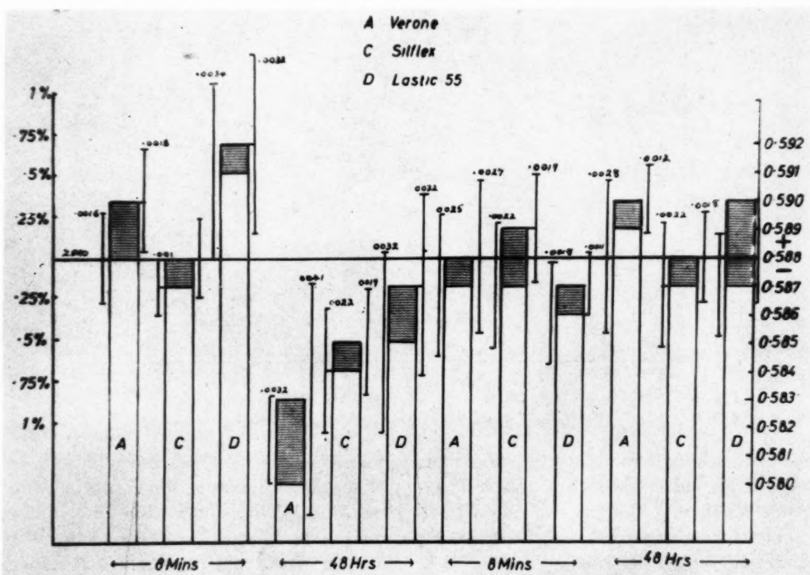


*Fig.* 6.—Dimensional changes of three silicone elastomers removed from an undercut steel die.

These results demonstrate the dangers of storing such impressions for long periods before casting, since the tray was unable to exercise any restraint on the central portion of material. In the case of those impressions held in the brass rings, a storage period of 48 hr. did not produce the same results, the stone models varying from zero to $+0\cdot35$ per cent. This result was probably due to the restraint exercised by the ring upon the silicone impression.

When the impressions in the brass rings were cast after 5 min. setting time the stone models varied between $\pm0\cdot2$ per cent—an error of little clinical significance. The 72 impressions in *Fig.* 4 are insufficient to establish a definite working range of accuracy, but certain facts do emerge from these tests:—

1. Silicone elastomers should be contained in well-fitting perforated trays allowing a depth of 4 mm. of impression material.

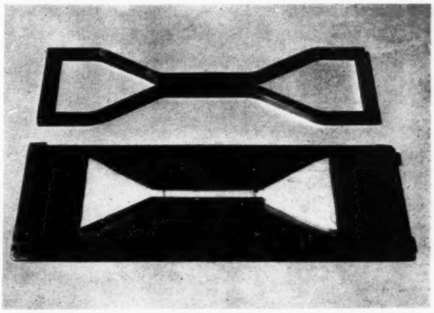

*Fig.* 7.—Brass template and mounting plate with dumb-bell shaped rubber test piece in position.

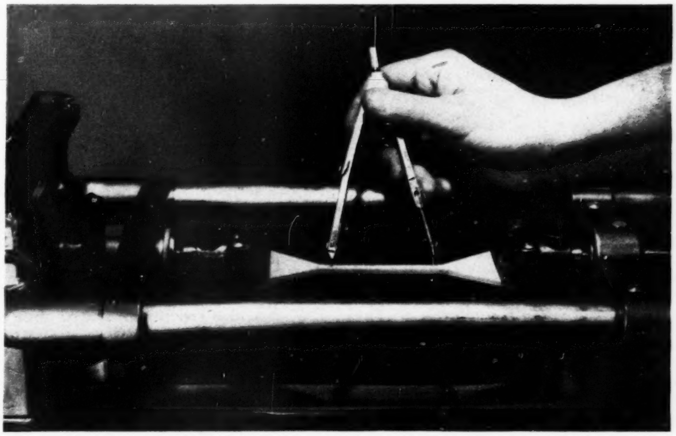

*Fig.* 8.—Hounsfield tensometer with rubber test piece under extension.

2. Storage periods of 24 hr. or more are detrimental to the accuracy of this type of elastomer. Shrinkage may occur which will prove clinically unacceptable and any silicone impression should be cast within 1 hr., particularly if a full tray has been used.

**Tension Set.**—The silicone rubbers have proved themselves very comparable to natural rubber and it is for this reason I chose the British Standards tension set test for rubbers. In order to classify the term "tension set" it may be helpful to quote the definition of tension set in Section 16.1, B.S.I. publication 903, part 16.

*Set*; *Tension Set*: Set is the residual strain in a rubber test piece after it has been subjected to stress for a given time and then allowed to recover in a given time, the temperature being substantially constant during the test. Tension set, hitherto commonly known as "permanent set" is the residual tension after stretching (*a*) to a given strain, or (*b*) under a given stress.

**Method of Testing.**—A brass template was used in which to mould the test pieces (*Fig.* 7). This template measured internally 18·5 cm. in length and the dumb-bell narrowed down to

form a centre column of approximately 6 cm. length, 0·5 cm. width, and 0·5 cm. depth, giving a cross-section area of 0·25 sq. cm., this area becoming the actual cross-section under test.

A brass plate was constructed to receive the template, which was held in a set position by angle pieces soldered to the corners of the base plate. The plate had two fine lines engraved at a distance of 5 cm. apart to coincide with the test portion of the template. In this way, two fine lines were registered on the impression material at the required 5-cm. length under test, and these lines were calibrated under the travelling microscope.

The materials were mixed according to the manufacturers' instructions, with the additional precaution of weighing the quantity of pastes used, and were moulded into the template set on the base plate, using a glass block to mould the upper section. The blocks and template were maintained at a temperature of 100° F. in a water-bath owing to the great effect of temperature upon the setting times of the silicone rubbers. Once the materials had been moulded under pressure, using a 28-lb. weight, the mould was transferred to an incubator maintained at 100° F. during the setting period. The time of set quoted against experiment includes the mixing and insertion time, e.g., for a 5-min. mix 1 min. was allowed for mixing, 1 min. for moulding, 2 min. at the curing temperature of 100° F., and 1 min. for assembling the test pieces in the testing machine (Hounsfield universal tensometer).

After removal of the test piece from the mould the two ends of the rubber dumb-bell were clamped in the tensometer using specially made screw clamps which would allow a universal jointed movement (*Fig.* 8).

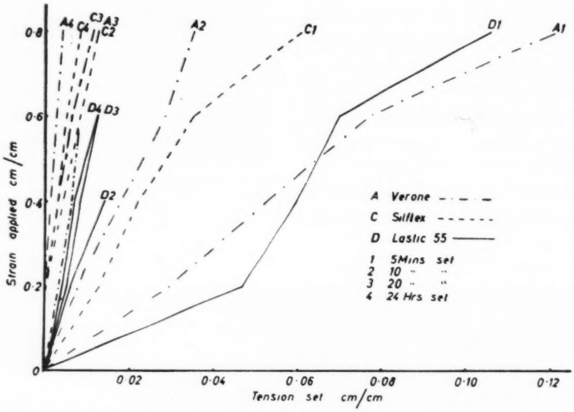


*Fig.* 9.—Tension set of three silicone elastomers at various setting times.

The tension-set experiments were carried out for a series of setting times of the three materials, namely, 5 min., 10 min., 20 min., and 24 hr. In each case a strain was applied, this being predetermined in the order of 0·2, 0·4, 0·6, 0·8 cm./cm. strain. For example, one of the 5-cm. test pieces was extended to 6 cm., giving an overall tension strain of 0·2 cm./cm. This strain was exerted for 1 min. and then released. The recovery time allowed for the material was 2 min., and after this interval the overall length of the test piece was measured under the travelling microscope. From this final length it is possible to determine the residual strain in the material by first calculating the difference between the original length and the extended length after recovery, and then dividing this figure by the original length. The result of this calculation will give the residual strain per unit length, which is also known as tension set. This is then

quoted as tension set for a given tension strain.

*Fig.* 9 illustrates tension set/strain applied for the four times of set of the three materials. If a series of tension-set readings for a strain of 0·4 cm./cm. (40 per cent strain) are taken, the following results are obtained:—

| | 5 *min.* (cm./cm.) | 10 *min.* (cm./cm.) | 20 *min.* (cm./cm.) | 24 *hr.* (cm./cm.) |
|---|---|---|---|---|
| Verone | 0·053 | 0·018 | 0·006 | 0·002 |
| Silflex | 0·022 | 0·004 | 0·003 | 0·003 |
| Lastic 55 | 0·060 | 0·008 | 0·008 | 0·007 |

These results show that there is a relationship between time of set and the optimum recovery figures at 24 hr. Silflex approaches its optimum recovery figure quicker than Verone or Lastic 55 at a 10-min. setting time. At a lower strain application of 0·2 cm./cm. Silflex will recover completely after 10 min. set and Verone after 20 min., within the range of measurable accuracy which this experiment allows. This is an ideal situation, but it should be noted that in the lower ranges of strain application all the silicone rubbers show a very low tension-set figure after a 10-min. mixing and setting time (7 min. setting time in the mouth).

I also tested a popular brand of Thiokol rubber for its tension set at an applied strain of 0·2 cm./cm. and after 10 min. setting time the resulting tension set was 0·028 cm./cm. As you will see from the graph, this compares unfavourably with the three silicone rubbers under similar circumstances. The tension-set figures were as follows:—

| | |
|---|---|
| Silflex – – | zero |
| Lastic 55 – – | 0·006 cm./cm. |
| Verone – – | 0·008 cm./cm. |
| Thiokol – – | 0·028 cm./cm. |

This particular brand of Thiokol did not attain a comparable figure until 30 min. had elapsed, owing to a creep in the material.

The following recommendations are, therefore, made when using silicone elastomers:—

The minimum setting time for a standard mix at mouth temperature should be 8 min. (3 min. mixing time and 5 min. in the mouth). A further improvement in the tension-set figures may be obtained with a 10-min. set, and it is advisable to adopt this longer setting time for extensive bridge abutment preparations and intracoronal preparations involving deep undercuts.

## SUMMARY

The silicone elastomers tested during this investigation had a limited shelf life, the pastes tending to thicken after three months. This proved a definite drawback during clinical use. However, I should point out that this problem is being overcome by the manufacturers. All the silicone materials contract during polymerization and, if left unrestrained, shrinkage figures as high as 1·2 per cent were observed. This shrinkage could be reduced considerably by restraining the impression in perforated trays, allowing a thickness of 4 mm. of impression material. However, long delays in casting the impression are not recommended.

These elastomers exhibited the best elastic recovery figures for any material yet used for dental impressions and the tension-set experiments indicate a promising future for them.

**Acknowledgements.**—I am glad of this opportunity to express my thanks to Mr. E. H. Davies, Senior Laboratory Technician, Department of Conservative Dentistry, who did most of the hard work during this investigation. My thanks are also due to Mr. W. J. Morgan, of the Photographic Department, for the preparation of the illustrations.

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### Long-term Anticoagulant Therapy for Coronary Thrombosis

In the case of patients undergoing long-term anticoagulant therapy for coronary thrombosis, many dental extractions have been performed without undue bleeding and without the need for any material alterations in the dose of the anticoagulant. It is considered most inadvisable to stop anticoagulant therapy completely in order to carry out surgical procedures; it is only necessary to ensure that the prothrombin times are at the lower therapeutic limit of approximately twice the normal control time when Quick's method is used, or 20–25 per cent by Owren's technique.—TOOHEY, M. (1958), *Brit. med. J.*, **1**, 473.

# THE NEW SCHOOL AT UMEÅ

By **ROY STORER,** F.D.S. R.C.S.
*Lecturer in Prosthetic Dentistry, University of Liverpool*

## INTRODUCTION

In February, 1958, the writer was fortunate to be able to visit the newly-built Dental School at Umeå in Sweden. The School is situated some two kilometres east of the centre of the town which lies on the north-east coast of Sweden, 500 kilometres from Stockholm. It is the intention of the Swedish Government that this School shall be the first faculty of the future University of Umeå and that the foundation of a seat of learning here will aid in the development of the northern part of Sweden. The choice of Umeå brought forth much public opposition in Sweden as there were at least three other towns in the north who put forth claims to have this new University built in their midst.

Although so far north, the climate at Umeå is most pleasant—perhaps the only drawback being the extended winter and reduced amount of daylight between the months of October and March.

The School is largely the work of Professor G. Westin, who is Rector of the Royal School of Dentistry in Stockholm. Prior to Umeå, Professor Westin created the fabulous Dental School at Malmö and the building of a fourth school at Göteborg has now commenced. This, it is said, will be an improvement even on the School at Umeå. The aim of the Swedish Government is to have 1 dentist per 1000 head of population; the present population of Sweden is 7,000,000 and the number of qualified dentists 3550. In an attempt to achieve the desired practitioner-patient ratio the normal yearly intakes at the Schools in Sweden are:—

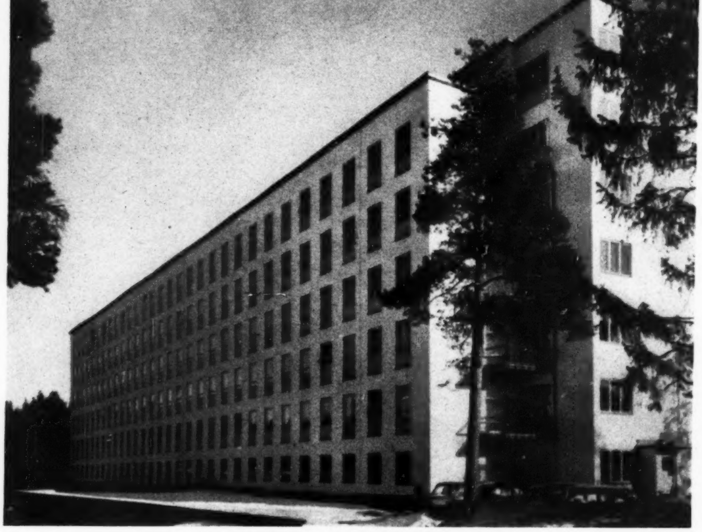

*Fig.* 1.—The Dental School at Umeå.

Stockholm } 50 in September and 50 in
Malmö } February.

Umeå—25 in September and 25 in February.

## THE SCHOOL AT UMEÅ

The Dental School (*Fig.* 1) is in an area earmarked for the development of a Medico-Dental campus and is attractively situated amongst forests of spruce trees. Much building is still to be done but dominating the scene are the buildings of the Dental School and the General Teaching Hospital. The building is rectangular in shape and occupies 5 floors, the contents of which are as follows:—

1st Floor—Professor of Prosthetics' suite, including his surgery and laboratory.
Surgeries and rooms for readers.
Board room.
Library.

2nd Floor—Admissions department.
Surgery and suite for the Reader in Oral Surgery.
Operating theatre.
Maxillo-facial and bite-rehabilitation surgeries.
Teachers' rooms and surgeries.
X-ray department.
"National Health" surgeries (used by senior lecturers and junior staff).

3rd Floor—Student clinic.
Central sterilizing room.
Instructor Nurses' suite.

4th Floor—Technicians' laboratory.
Photography department.
Research laboratories.
Phantom room and laboratory for clinical students.
Teachers' rooms.
Materials laboratory.

5th Floor—Two lecture theatres.
Students' rooms.

At the present time, students complete their first year of study at Stockholm and then commence their prosthetic and conservative phantom course. On completion of these courses the students graduate to the main "Central Clinic" which is the outstanding feature of the Dental School at Umeå.

## THE CENTRAL CLINIC

The idea of a central clinic is not new; there are a number of examples of this type of teaching department in schools in America. Umeå is, however, the first school in Europe to have such a central clinic.

In this department there are 48 cubicles, each equipped with chair, modified unit, instrument cabinet, operating stool, and wash basin (*Figs.* 2 and 3). The cubicles, open at one end, are 145 cm. high—a height which affords some privacy for the patient whilst permitting observation by the staff even from a distance. On the left side of the open end of each cubicle there is a vertical row of 4 different coloured lights. By pushing the appropriate control-button the student causes a particular light to be illuminated which signifies that he wishes the assistance of either a teacher in conservation, prosthetics, or periodontology.

All conservative, periodontal, and prosthetic treatment for a particular patient is carried out in the same cubicle. The specialist teaching staff come to the student and the patient rather than vice versa, as occurs in most other dental schools. Such co-operation between the teaching staff should lead to a better understanding of the ideal treatment plan on the part of the student.

Between the two rows of cubicles, which face north and south respectively, is the sterilizing room (*Fig.* 4). All instruments used by students in Sweden are State owned, and in the sterilizing room at Umeå the student is able to draw the particular kit of instruments he requires for the treatment in hand and then return them for cleaning and sterilizing. There are three complete kits of instruments for each clinical student so that there is never a shortage of equipment.

The training of dental nurses is undertaken at the School and therefore the student has the opportunity of operating with the assistance of a nurse during the whole of his clinical course.

Surgical treatment is performed in the cubicles and theatres on the second floor (*Fig.* 5). All surgery is performed under the most strict aseptic technique and almost without exception under local anæsthesia.

The X-ray Department is elaborate. There are four tubes plus cephalostat and a Lysholm

skull X-ray table, and in addition there are further tubes in the Teachers' Clinic (mainly for control of root fillings) and two in the

*Fig.* 2.—A wing of the Central Clinic.

*Fig.* 4.—Part of the sterilizing room.

Student Clinic. By law there are strict precautions against possible radiation hazard; all walls and doors of the X-ray rooms are lined with lead and the operator goes into a lined cubicle before making an exposure.

The Children's Dentistry Department including orthodontics has its own separate building in the centre of the town. This is to enable a closer contact between the department and the primary and secondary schools in Umeå. There are 12 cubicles in the Central Clinic, which is similar to that in the

*Fig.* 3.—The interior of a cubicle.

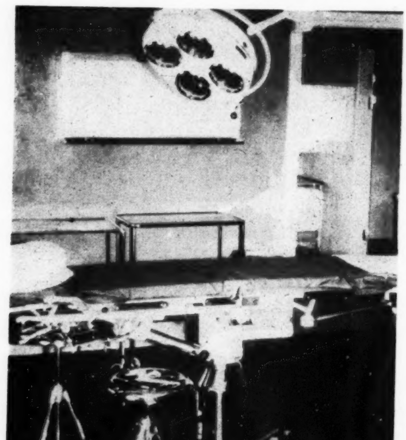

*Fig.* 5.—One of the operating theatres.

main School building. There are an additional 3 chairs in the Teachers' Clinic and 7 more which are used by dentists employed by the

State to treat children from the primary and secondary schools in Umeå.

### THE TEACHING STAFF

All the teachers in the Dental School are part time; demonstrators and lecturers have 3 hours teaching duty per day; senior lecturers 3½ hours; readers 4 hours; and professors 5 hours.

The allocation of staff to the various departments is as follows:—

| | *Professor* | *Reader* | *Senior Lecturer* | *Lecturer* | *Demonstrator* |
|---|---|---|---|---|---|
| Prosthetics | 1 | 1 | 3 | 3 | – |
| Conservation | – | 1 | 2 | 3 | – |
| Oral surgery | – | 1 | 1 | 1 | 1 |
| X ray | – | – | 1 | – | 1 |
| Endodontia | – | – | 1 | – | 1 |
| Admission | – | – | 1 | – | – |
| Bite analysis | – | 1 | – | 1 | 1 |
| Orthodontic and Pedodontic | – | 1 | 1 | 2 | 3 |

The gradings of the senior staff appear to be similar to those in British Schools and the demonstrators are equivalent to house officers.

In contrast to other schools in Sweden, none of the teachers at Umeå is employed in private practice. During their non-teaching sessions they work either in the "Teachers' Clinic" or their own surgeries treating cases of special interest and perhaps complexity for which they receive remuneration from the State.

### A COMPARATIVE EVALUATION

As mentioned, the outstanding feature of this fine Dental School is the Central Teaching Clinic. Often thought of as an ideal, here at Umeå it is seen in reality. How much the students will benefit remains to be seen, but certainly team-work, which is an essential part of the treatment of a patient in any hospital, can here be exercised to the full. The students will probably gain the most, but many members of the staff may feel that their specialist training in an individual field of dentistry has to some extent been wasted. If the idea of a central clinic is to be a success it is possible that the training of the future teachers may change. It might be preferable for such men to be trained in several of the main fields of dentistry and for them to be then engaged as "Clinical Teachers".

**Acknowledgement.**—The writer wishes to thank the General Dental Council and the University of Liverpool for financial assistance; also Mr. J. S. Bailie for reproduction of photographs from original transparencies.

### Reaction of Gingival Tissues to Self-curing Acrylic Restorations

Although much work has been done to show the effect of filling materials on the dental pulp, little is known of their effect on the gingivæ. Experiments were conducted, therefore, to demonstrate the histological changes that occurred in the gingivæ adjacent to acrylic fillings.

Twenty-three cavities were cut in the teeth of four monkeys and two dogs. Each preparation was extended to the bottom of the gingival crevice. The cavity was filled, using the brush technique and a stainless steel matrix. Six restorations were polished one hour after filling, the others were left unpolished. The toothbrush was applied daily to ten of the teeth filled. The time between filling the tooth and filling the animal varied from 13 to 338 days.

Clinically there were no specific changes in the gingivæ. Histologically, however, all specimens showed a severe inflammatory response characterized by heavy accumulations of plasma cells and lymphocytes. The epithelium in contact with the acrylic was very thin, and epithelial pegs extended deeply into the connective tissue. A plaque-like material was found on the surface of the acrylic in 15 out of the 23 cases. Crevices between the acrylic and the cavity wall were shown to exist by virtue of the collection in those sites of debris, plaque material, and epithelial ingrowths. Some restorations had overhanging edges, but these did not alter the histological picture. The cause of these reactions was thought to be due to the plaque material and the acrylic resin itself rather than mechanical irritation.

WAERHAUG, J., and ZANDER, H. A. (1957), *J. Amer. dent. Ass.*, **54,** 760.

# A SIMPLIFIED METHOD OF ROOT-CANAL THERAPY*

By **GEORGE G. STEWART**, A.B., D.D.S., F.A.C.D., *Philadelphia*

THE chief function of root-canal therapy is to maintain the vitality of the tooth after the pulp has been removed. Since such a tooth is not a dead structure, but a truly vital one receiving its nourishment through the peri-odontal membranes and its support from the bony socket, if it is properly handled it can continue to function as it did when the pulp was present.

Fortunately, most teeth requiring root-canal therapy will respond to routine methods of treatment. This consists primarily of the careful chemo-mechanical preparation of the canal and careful and complete obturation of the canal. Beyond these measures we must depend upon the natural defence mechanisms of the body to repair those tissues that have become pathologically involved.

There are certain instances where we must resort to surgical intervention to achieve our goal of maintaining the vitality of the pulpless tooth. The most common of these are:—

1. A tooth with a very large area of peri-apical pathology.
2. A tooth with evidence of peri-apical resorption.
3. A tooth in which the apical third of the tooth has been fractured, and the pulp has undergone degenerative changes.
4. A tooth which will not yield growth-free cultures.
5. A tooth in which a root-canal instrument has been broken, and protrudes beyond the apex of the root.
6. When the peri-apical tissues have become irritated, as a result of inadvertent overfilling of the root canal.
7. Where there is progressive apical pathology in a tooth which has been previously treated via root-canal therapy.

There have been many methods proposed for surgical endodontics. The earliest record of such intervention has been described by Desirabode, who, according to Sommer (1956), was the first to have performed a root resection, in 1843. Since that time there have been many who have advocated the surgical treatment of infected teeth. We must, however, realize that at that time the causative agents associated with infection were not widely recognized or thoroughly understood. The X-ray was not known, and the recognition of peri-apical pathology by this means was therefore impossible.

The methods were, at best, quite crude, and frequently only surgery was done, and the canal itself was not treated.

At the present time there are four popular methods of surgical endodontics used. They are:—

1. Root resection following routine root-canal therapy, and employing culture technique.
2. Immediate root resection, where the teeth to be treated are prepared, sterilized, the canals filled, and then surgery is instituted.
3. Post-resection technique, which consists of peri-apical surgery first, and then with the canal apex wide open, the canal is enlarged, irrigated, and sealed. The excess gutta-percha, which is visible as it comes through the open apex, is removed and condensed against the stump of the tooth.
4. Root-end sealing technique, where the peri-apical surgery is also performed first, and then a filling of some kind is placed in the apex of the tooth.

Each of these methods has its advocates, and each has its place. There are, however, certain disadvantages in each method.

These are as follows:—

1. In root resection, following complete therapy, it is my feeling that when complete root-canal therapy has been performed in the course of several visits, and negative cultures have been obtained, normal healing will result

* A paper delivered to the American Dental Society of Europe, August 29, 1957.

without further intervention. Why then resort to surgery?

2. The immediate resection technique is a more logical approach, for here we save time. The canal is treated, deliberately over-filled to assure a complete seal; then the surgery is instituted, and the granulomatous tissue and the tip of the root are removed, all in one visit. I feel that the chief objection to this method is the removal of the root apex, or that portion of the root which is surrounded by peri-apical pathology. There are instances where this procedure would leave so little root structure that the crown–root ratio would be most unfavourable for maintaining the tooth in function.

*Fig.* 1.—Central and lateral incisor teeth opened for drainage prior to surgical intervention.

3. In the post-resection technique, I feel that we tend to force the necrotic tissue from the canal into the previously cleansed peri-apical region. It is also difficult to prevent tissue fluids from gaining access to the canal, through the wide apex, during obturation of the canal.

4. I feel that the root-sealing technique is the least desirable. However, there are instances in which it is the only approach feasible. The chief indication for employing this method would be when root-canal therapy had been previously performed, and a post is present upon which a crown has been placed. Or else the tooth in question might be part of a large bridge, and by removing the post and bridge the tooth itself might crack and consequently be lost. Of all four methods, in this one we have the greatest potential for failure, because merely sealing the apex would not take care of the necrotic tissue which might still be present within the root canal or in lateral canals.

*Fig.* 2.—Teeth treated as described. Splinting was resorted to in order to keep the teeth from being lost.

I feel that the most logical approach is that which was introduced by Weaver. In this method, the root apex is not amputated, but the granulomatous tissue alone is removed from the involved area. When healing has taken place we have a more favourable crown–root ratio, and the probability of maintaining

the tooth for a greater number of years is increased.

Grossman (1950), however, has stated the following, when discussing Weaver's method of peri-apical curettage: "The disadvantage of peri-apical curettage is inaccessibility of some areas to the curette, and the possibility of leaving behind necrotic or infected material, that is ordinarily exposed to view after the root end is removed." In order to overcome this definite disadvantage, I have somewhat modified Weaver's procedure, and will present the method which I have successfully used for the past ten years.

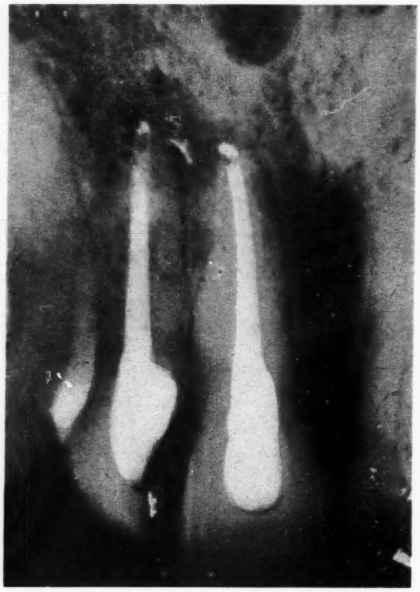

*Fig.* 3.—Marked bone repair in nine months.

*Fig.* 4.—A lower central incisor tooth with a condition similar to case shown in *Fig.* 1.

## METHOD

After determining by careful examination that the tooth or teeth in question should be treated surgically, the patient is prepared for the procedure. However, if there is an acute peri-apical abscess present, every effort should first be made to reduce this inflammatory reaction by appropriate means.

Prior to surgery, the patient is given a sedative to allay fear and apprehension. An antihistamine compound is also given at this time. This will help to reduce the post-operative sequelæ which formerly followed surgical intervention. I have been using the 8 mg. repetabs of chlor-trimeton for this purpose, with gratifying results.

The area upon which we will operate is then carefully placed under anæsthesia. After this, the rubber dam is applied. The tooth, or teeth, involved are carefully washed with untinted tincture of metaphen and then alcohol. Entrance to the pulp-chamber is then gained through the area of the cingulum. This is generally done with a round, carbide bur.

Once the pulp chamber has been opened, a flame bur, or tapered diamond stone, is used to widen the entrance. Then, with a small round bur, the pulp horn areas are cleansed. This will prevent future discoloration of the crown of the tooth. Under no circumstance should we attempt to enlarge the canal through a Class III cavity in the side of the tooth.

This procedure will generally result in the breakage of an instrument, a perforation of the root, or at best in inadequate cleansing of the canal. It is always desirable to work in a straight line where possible.

The necrotic material in the pulp-chamber is then carefully scooped out with spoon excavators. Before instruments are placed in the canal itself, the chamber is carefully flushed several times with ordinary 3 per cent hydrogen peroxide followed by a sodium hypochlorite solution. I have been using the commercially available zonite, which is a double strength chlorinated soda solution. The effervescence created will wash debris from the canal and act as a mild medicament as well. The sodium hypochlorite solution will tend to digest the necrotic material in the canal.

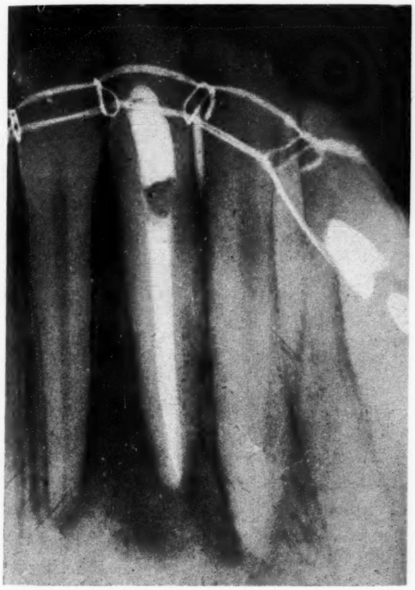

*Fig.* 5.—Tooth after treatment requiring splinting to maintain it.

After there is no debris left to flush from the canal, we use a barbed broach which will fit loosely in the canal and still be large enough to enmesh pulp tissue that may be present. After the tissue has been removed with this instrument, the canal is again flushed with alternating solutions of hydrogen peroxide and sodium hypochlorite, as above.

We next select the root-canal reamer or file that will fit to the apex of the tooth, and carefully clean the canal. The canal is again flushed before proceeding to the next size of instrument. This procedure is repeated until the chemo-mechanical preparation of the canal has been completed.

*Fig.* 6.—Same tooth one year after therapy as described.

As reported by the author (1955), this method of canal preparation has yielded a high percentage of growth-free cultures without the use of additional medicaments. These results have been verified by M. B. Auerbach (1953).

The canal is now ready for obturation. It should first be thoroughly dried with either electric drying points or absorbent points. Then a gutta-percha point which will fit snugly to the apex is selected. J. Kluczka (1953) has reported the substance, diaket, which is a neutral polyketon, for root-canal filling. This has also been reported by

A. Mayer (1954) and Trauner and Waechter (1953). They have found that diaket is very effective. I, too, have found after extensive laboratory and clinical investigation that this material is most effective.

However, I use the material in a different manner from the above men. I have used it as a sealing agent, in conjunction with gutta-percha points or silver root-canal points. The method of sealing is as follows. After the canal has been thoroughly dried, and the original gutta-percha point has been selected, the diaket is mixed as prescribed to a creamy consistency. The gutta-percha point is rolled in the diaket and carried to the canal, where it is pumped in several times. The point is then forced to the apex until it will go no farther. A No. 3 gutta-percha spreader is then pressed alongside the original point, which is forced forward and laterally. The spreader is then gently rotated to break the seal, then removed, and an additional thinner gutta-percha point is inserted. A small amount of diaket is added to this point as well. This procedure is repeated until no additional points can be added.

*Fig.* 7.—An ideal place for root-end filling. The canine tooth-post and crown—an abutment for a fixed bridge. Trying to remove this bridge might cause the loss of bridge and tooth.

*Fig.* 8.—Six months after root-end filling. Complete healing in spite of poor "root filling" within the canal.

In this instance we attempt slightly to over-fill the root apex to ensure thorough sealing. There are several advantages to this combination. For years gutta-percha has been used successfully, and it is known to be well tolerated by the body tissues. Diaket is also well tolerated and has the additional advantage of being insoluble in body fluids. Also, it is white and will not discolour the tooth. It helps to prepare a very dense filling, and contains 2,2-dioxy-5,5-dichloro-diphenylmethan, which has marked anti-bacterial activity, and will further reduce micro-organisms which might be present in the canal.

After the canal has been completely obturated, we remove the excess gutta-percha and cement from the pulp chamber to a point apical to the gingival tissue. This will permit better translucency of the crown of the tooth. To brighten the tooth further, a pledget of

cotton-wool saturated in superoxol (a 30 per cent hydrogen peroxide solution) is sealed in the chamber of the tooth. This material is removed at a future date, when the final restoration is placed in the tooth.

The rubber dam is next removed, and the patient is given a booster shot of a local anæsthetic solution. When maxillary anterior teeth are being treated, it is wise to infiltrate the anæsthesia in the anterior palatine canal region as well as in the muco-buccal fold. In lower teeth, I prefer the mandibular block in addition to the anæsthetic deposited in the muco-buccal fold in the area of surgery.

The mouth is carefully draped by having the patient bite on several thicknesses of sterile gauze pads. Additional pads are tucked in the cheek region to prevent saliva from getting into the area of operation.

The tissues are then swabbed with untinted tincture of metaphen, and the incision is made. The incision should be made, whenever possible, in the region where the attached and unattached gingiva meet. It should extend, on sound structure, the distance of one tooth on either side of the involved area. If an aspirator is available, it will be very useful in removing blood and saliva from the area of operation. However, this function can be performed with sterile surgical sponges in the absence of an aspirator.

The tissue is retracted, making certain that the periosteum is lifted with the soft tissue. Generally, there will be a very large area of pathology in those teeth which require surgical intervention. Frequently, when the buccal tissues are lifted, we will find that the outer plate of bone has already been destroyed by the pathological process. If the buccal plate is still present, it will generally be as thin as an egg shell and easily removed with a spoon curette or a sharp surgical chisel.

The large spoon curette is first employed to remove as much of the granulomatous tissue as possible. We next use periodontal-type curettes. With their curvature it is possible to reach behind the root apex to remove the granulomatous tissue present there. With the straight spoon curettes this is impossible. The No. 17 and No. 18 periodontal curettes are useful for this purpose. If these instruments cannot be inserted behind the root, it is wise to remove additional bone structure in order to gain access to this area rather than remove the apical end of the root. The removed bone will regenerate, whereas the tooth structure itself will not, once it has been removed.

The curettes can be used to smooth the root surface, and to get into the fine tortuous areas, which we may find surrounding the body of the root. When the root surfaces have been planed smooth, a small surgical file, or periodontal file, is used to round off the root apex if there is any evidence of erosion.

After all of the pathological tissue has been removed, the resultant cavity is irrigated with a carpule of anæsthetic solution, which is readily available and sterile. If the cavity is a large one, oelfoam, or some similar absorbable mesh, is then placed in it. This acts as a framework upon which the blood-clot will form. An antibiotic substance can then be dusted into the cavity, although this is not essential.

The lips of the wound are brought together, and sutured into position with thin 0000 surgical silk. I prefer to use a number of interrupted sutures to bring the tissues together. Final X-rays are then taken, so that we may, at future intervals, take additional X-rays for comparison and note the rate of healing.

After surgery I generally prescribe an antibiotic which the patient is known to tolerate. And in order to help reduce the post-operative sequelæ of pain, swelling, and discoloration, I have been advocating the use of antihistamine compounds for 2–3 days post-operatively. I am happy to report that, as a result of this, the discomfort which generally followed these surgical interventions has been largely eliminated.

The antihistamines block or bind the release of histamine which is liberated when tissues are traumatized, as during surgery. This then reduces the inflammatory reaction with its swelling and discoloration. Discoloration in patients with low capillary fragility, and those with very fair skins will be present, however,

to a lesser degree. The pain and swelling will be markedly reduced.

The patient is also instructed to use cold applications, on the outside of the face, over the area of surgery. This is repeated every two hours, for about five-minute periods, for the first day or two after surgery. The patient is also told not to raise the lip, in order to avoid the possibility of tearing out sutures; and to adhere to a diet which will not require a great deal of heavy chewing. Warm salt-rinses are suggested after each meal, to remove the material which might accumulate around the sutures.

The sutures are removed in approximately one week. If one, or more, of the sutures has been torn from position as a result of excessive motion, a blow, or of raising the lip, closure will ensue, generally without the need of further intervention.

## SUMMARY

1. The various surgical techniques which are commonly employed in endodontics are presented, with comments as to their feasibility.

2. A suggested method of treating endodontically involved teeth in one sitting, retaining a maximum amount of root structure, is introduced.

3. With the appropriate pharmacological adjuncts, we may reduce the post-operative sequelæ to a negligible degree.

## BIBLIOGRAPHY

AUERBACH, M. B. (1953), "Antibiotics versus Instrumentation in Endodontics", *N.Y. dent. J.*, **19**, 225.

GROSSMAN, L. I. (1950), *Root Canal Therapy*, p. 336. Philadelphia: Lea & Febiger.

KLUCZKA, J. (1953), "Die Wurzelfullung", *Zahnärztl. Prax.*, **10**, 2.

MAYER, A., and others (1954), "Die Exstirpation der Pulpa Unter Anwendung der Querschnitts—Mess Methode Nach Dr. A. Mayer", *Zahnärztl. Rdsch.*

SOMMER, R. F., OSTRANDER, F. D., and CROWLEY, M. C. (1956), *Clinical Endodontics*, p. 323. Philadelphia: W. B. Saunders.

STEWART, G. G. (1955), "The Importance of Chemo-Mechanical Preparation of the Root Canal", *Oral Surg.*, 993.

TRAUNER, R., and WAECHTER, R. (1953), "Untersuchungen Über das Wurzelfullmittel Diaket", *Zahnärztl. Welt.*

# EMERGENCY TREATMENT OF DISLODGED INCISORS USING SOFT ALLOY SPLINTS

By **GEOFFREY L. SLACK** and **RICHARD H. BIRCH**

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## INTRODUCTION

THE success of replantation depends on many factors, the more important of which are:—

1. Replantation at the earliest opportunity.
2. Minimal damage to tooth, especially the cementum and supporting tissues.
3. Avoidance of contamination of the root surface before replantation.
4. The removal of the pulp and filling of the root canal.
5. The removal of the blood-clot from the socket.
6. Immobilization after replantation to allow for rest and repair.

Since the object of the treatment is to achieve reattachment, one of the most important factors is to preserve the vitality of the periodontal membrane, which usually detaches itself from the socket, and adheres to the cement surfaces of the tooth. Stones (1954) considers that whilst humidity and atmospheric temperatures influence the life of the periodontal membrane, it cannot survive much longer than half an hour once it has been removed from the socket. Therefore, the longer the delay in replanting the tooth, the less the chance of success. An incisor which has been dislodged and then replanted requires a device to retain it in the socket. The use of some form of dental splint is necessary to allow healing under optimal conditions of rest.

## AVAILABLE METHODS OF SPLINTING

The available methods of splinting are:—

1. Cast metal cap-splint.
2. Processed acrylic or moulded perspex splint.
3. Welded stainless steel bands.
4. Interdental wiring.
5. Immediate splinting with soft alloy.

**1. The Metal Cap-splint.**—Requires the taking of impressions, followed by laboratory work to complete the appliance. This type of splint, when cemented in place, is strong and rigid; it is often difficult to remove at a later stage.

There is much delay in fitting on account of the many stages before completion, so that some form of temporary immobilization must be employed before this splint can be cemented.

**2. The Processed Acrylic Splint.**—This is made in clear or preferably tooth-coloured acrylic. Preparation requires impressions and laboratory work, again involving much delay before ready for use. It is rigid and æsthetic but, due to its elasticity, not so retentive. It requires a greater bulk of material than the metal cap-splint. Perhaps the most effective splint of this type has been described by Horsnell and Brown (1956).

**3. Welded Stainless Steel Bands.**—Stainless steel incisor bands as used in orthodontic fixed appliance therapy are fitted to the replanted and adjacent teeth. The bands are then removed and welded to each other and/or to a labial arch wire. Hartsook (1948) developed a method along these lines using 0·028 mm. stainless steel ribbon arch wire and 0·01 mm. ligature wires.

These methods are useful, but require the use of a welder in the surgery and provide difficulties in cementation where several bands have to be placed simultaneously. The technical procedures are lengthy.

**4. Interdental Wiring.**—This has been employed as a temporary measure whilst awaiting the construction of a more permanent splint. The method employed is similar to that used for immobilizing fractured jaw segments, but suffers from several disadvantages in that it may induce paradontal damage due to pressure and the initial lack of rigidity is further increased after twenty-four hours when the wires begin to stretch. The introduction and position of the wires into the interdental spaces may also damage the soft tissues. Removal before placing a more lasting splint is not easy.

**5. The Immediate Soft Alloy Splint.**—A technique of dealing with these cases has been successfully used in Liverpool. The splint consists of a soft alloy plate, moulded by finger pressure and enclosing a thick layer of Ames Black Copper Cement, which invests the teeth adjacent to and including the replanted tooth.

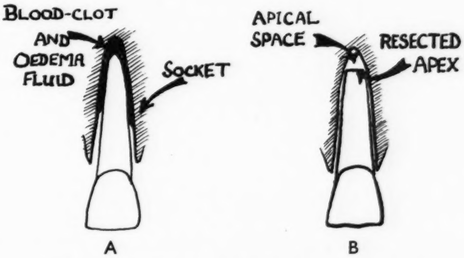


*Fig.* 1.—A, Blood-clot and œdema preventing seating of untrimmed root in the socket. B, after removal of apical 2 mm. and blood-clot. Apical space allowing for collection of inflammatory fluids without displacing root from close contact with socket.

*Materials.*—The soft alloy plate is readily available from milk-bottle caps, and the Ames Black Copper Cement is used on account of its ability to set in the presence of moisture and also its antiseptic properties as described by Turkheim (1953).

*Advantages.*—

*a.* This method is a direct application of the splint to the teeth and therefore involves no delay in firm replantation of the root.

*b.* The splint is very rigid, holds the replanted tooth firmly in place, and withstands mastication forces well.

*c.* It is well tolerated by the soft tissues so that it promotes healing of any lacerated tissues by means of its peripheral extension.

*d.* No laboratory work is necessary; the technique is simple.

In the early stages of its use, impressions were also taken and a cast splint prepared, but it has been found, however, that in most cases the splint was satisfactory even after three months. If the splint is damaged renewal is easy.

*f.* Remove blood-clot and lightly curette socket. The area is now isolated with cotton rolls and saliva ejector, and the tooth firmly seated in its socket.

*g.* A thin mix of Ames Copper Cement is flowed onto the adjacent teeth.

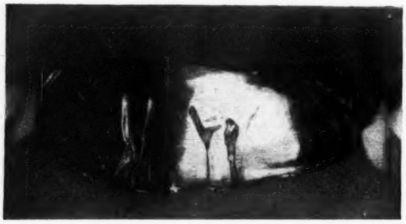

*Fig.* 2.—Photograph of splint in position.

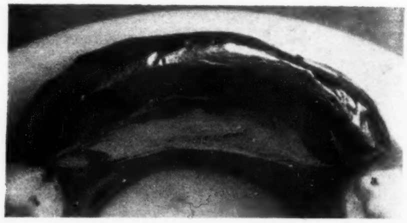

*Fig.* 3.—Photograph of occlusal view of splint.

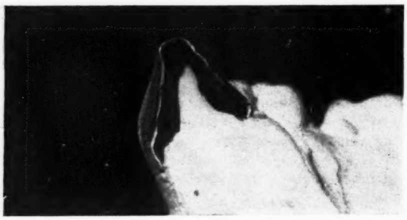

*Fig.* 4.—View of cross-section of cemented splint showing edges burnished.

*Fig.* 5.—Radiograph showing splint in position.

*Outline of Procedure.—*

*a.* Holding the dislodged tooth by the crown in a napkin, wash the root surface in a sterile dish with normal saline/penicillin solution. On no account should the cementum surface be scraped, damaged, or allowed to dry.

*b.* The apical 2 mm. of the root is removed with a disk. In addition to facilitating pulp removal, this allows a closer apposition of the surfaces of the root and socket when the tooth is replanted. (*Fig.* 1.)

*c.* From the apical end, the pulp is removed, the root canal reamed and filled with gutta-percha.

*d.* A milk-bottle top is then adapted to cover the dislodged and two adjacent teeth on either side, leaving space for the underlying cement.

*e.* Peripheral trimming of the metal to allow labial extension to cover lacerated soft tissues if necessary.

*h.* The prepared splint is about half-filled with cement and gently inserted, so that the dislodged tooth is held in position. (*Figs.* 2 and 3.)

*i.* Check occlusion.

*j.* When the cement has set any edges of metal are burnished over. (*Fig.* 4.)

*k.* Instructions are given to the patient concerning post-operative care, including oral hygiene and diet.

*Post-operative Care.*—The patient is recalled after four/five days for examination, but told to attend before if symptoms develop. (*Fig.* 5.)

The splint should be removed after eight to twelve weeks. The method of removal is to strip off the soft alloy splint. Fracture lines are cut in the cement both vertically and along the incisal edge with a bur. The sections are split off using a plastic instrument, avoiding undue pressure on the teeth. Interdental spaces are checked and cleared of cement

debris. The replanted tooth is then tested for mobility and occlusion.

## CASE REPORTS

*Case* 1.—A boy aged 7½ years had $|\overline{1}$ knocked out as a result of a fall in the roadway. The patient's mother recovered the tooth and attempted to put it back herself. The patient attended and the tooth was replanted after pulp removal and then splinted. Although the prognosis was poor the tooth was firmly in place, nineteen months after replantation. However, radiographic evidence showed that resorption had commenced by that date. (*Fig.* 6.)

*Fig.* 6.—*Case* 1. Radiograph after three months.

*Case* 2.—A boy aged 8 years had $\overline{1}|$ dislodged by a blow. Replanted after half an hour. After three months nearly all the splint is removed except the small bridge behind $\overline{1}|$. The replanted tooth is now firm. (*Fig.* 7.)

*Case* 3.—Replanted $\underline{1}|$ following blow. (*Figs.* 5 and 8.)

The radiographs show good paradontal regeneration, and mobility had returned to normal compared with neighbouring teeth, indicating probable attachment rather than ankylosis.

There is in the literature reference to many cases of replantation; the life of such teeth is variously quoted from 1 year to as much as 28 years. (Sommer, Ostrander, and Crowley, 1956.)

## COMMENTS

There have been few complications. In one case the soft alloy splint was not trimmed sufficiently from the labial sulcus. The œdema of the tissues caused undue pressure and ulceration occurred. This pressure was relieved by cutting away the excess and re-burnishing the soft alloy. This did not, however, interfere with the replantation.

This technique has its limitations, for it can only be applied to one, or at the most two dislodged teeth, though it may still be useful as a temporary expedient until more extensive splints can be prepared. A further disadvantage might be suggested in that since all the teeth of one jaw are not covered by the splint, the resultant occlusion cannot be ideal; in practice, however, this has not proved to be a contra-indication for its use.

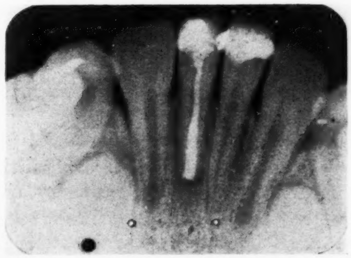

*Fig.* 7.—*Case* 2. Radiograph after three months.

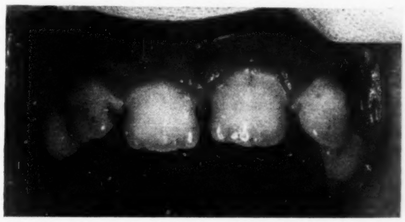

*Fig.* 8.—*Case* 3. Photograph 17 months after replantation.

## SUMMARY

A useful form of emergency treatment for children's dislodged incisors is discussed, together with the technique and factors influencing the favourable outcome of replantation.

**Acknowledgement.**—Our thanks are due to Mr. S. Bailie, Photographic Department, University of Liverpool School of Dental Surgery, for the production of the photographs.

## REFERENCES

Hartsook, J. T. (1948), *J. Amer. dent. Ass.*, **37**, 554.

Horsnell, A. M., and Brown, G. (1956), *Dent. Practit.*, **6**, 148.

Sommer, R. F., Ostrander, F. D., and Crowley, M. C. (1956), *Clinical Endodontics.* London: W. B. Saunders.

Stones, H. H. (1954), *Oral and Dental Diseases.* Edinburgh: E. & S. Livingstone.

Turkheim, H. J. (1953), *Brit. dent. J.*, **45**, 1.

# BOOK REVIEW

**A MANUAL OF DENTAL ANÆSTHESIA.** An Illustrated Guide for Student and Practitioner. By W. Harry Archer, B.S., M.A., D.D.S., Professor of Oral Surgery and Anæsthesia, School of Dentistry, University of Pittsburgh. Second edition. $9\frac{1}{4} \times 6$ in. Pp. 346 + xv with 174 illustrations. 1958. Philadelphia and London: W. B. Saunders Co. Ltd. 59s. 6d.

This book has tried to cover local and general anæsthesia in dentistry but it has not, in my opinion, given sufficient attention to detailed techniques. A dentist does not, as a rule, give endotracheal anæsthesia nor use open ether for general anæsthesia, and it is felt that so much has been included which comes within the province of a specialist anæsthetist that need not have been written in a book which is mainly for the benefit of the dental student and the dental practitioner.

The book opens with a chapter on the history of anæsthesia, a chapter of much interest and information. The first part of the book deals with local anæsthesia under the following headings: Local anæsthetic solutions; Local anæsthesia; Anæsthesia for operative dentistry and root canal therapy; Post-injection complications. Figs. 110, 111 make one think of the advisability of such a procedure—injecting directly into a tissue which is supposedly infected.

The second part of the book has nine chapters dealing with general anæsthesia under the following headings: Pre-anæsthetic examination; Preparation of ambulatory patient; Free airway; General anæsthesia in the surgery; Analgesia; General anæsthesia for oral surgery; Endotracheal anæsthesia; Complications and their prevention and treatment; and Pre-operative recognition and treatment of bronchopulmonary disease. This last chapter is hardly necessary in a book on anæsthesia in dentistry as the diagnosis and treatment of bronchopulmonary disease is more in the domain of the general medical practitioner and the specialist anæsthetist.

The final chapter on the legal aspects of anæsthesia, a useful and perhaps an important one in a book of this description, must be read with care and knowledge of local rules and regulations, as the facts mentioned may not be of universal application. Could one say that in these days a reference to hypnosis could easily be omitted from a book on dental anæsthesia?

On the whole, it is a useful book, written with assurance and much practical wisdom, illustrated with clear and well-reproduced diagrams and photographs. Some of the views expressed so ably by the twelve contributors are rather extreme, but these need not detract from the value of this book to the dental profession.

H. M.

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### Some Alveolar Bone Findings in Hospitalized Patients

Roentgenograms of 169 male patients in the New York Veterans Administration Hospital were examined in a blind study. These ranged in ages from 20 to 49 years and represented patients who were classified into a medical study group, a neuropsychiatric group, and a control group of hæmorrhoids, fractures, etc., which could not be expected to affect the alveolar bone. Mesial and distal surfaces of selected teeth were studied as to the presence or absence of slow resorption. In addition the ratio of the remaining alveolar crest to the root length was studied. All these scores were averaged for each patient, age group, and diagnostic grouping, and the findings compared.

It was found that: (1) The medical group had an alveolar bone loss similar to the control group. Both groups showed the same significant bone loss with increasing age; (2) The alveolar bone scores of the neuropsychiatric group did not decrease with age as much as the medical or control group; (3) The visible lamina dura decreased with age and not with diagnostic grouping; (4) The amount of slow resorption increased with age and not with diagnostic grouping.—Blacharsh, C., Staub, D., and Margolis, R. (1958), *J. Periodont.*, **29**, 53.

# THE EARLY ORTHODONTIC TREATMENT OF CLEFT PALATE CONDITIONS

By **W. R. BURSTON**, Ph.D., D.Orth. R.C.S., L.D.S.
*School of Dental Surgery, University of Liverpool*

THE title of this paper, "The Early Orthodontic Treatment of Cleft Palate Conditions", was selected in the interests of brevity. It is intended to include both clefts of the primary and secondary palates and also to embody the morphological rationale of what might more justly be described as the McNeil technique.

It is now some 4 years since McNeil (1954) first published his original work on the early orthodontic management of cleft palate and hare-lip conditions, and those who have followed this work will be aware of the storm of controversy which it aroused, both in the field of orthodontics and also in that of plastic surgery. It will be remembered that the centre of this conflict was whether or not it was possible to secure union of a cleft palate by non-surgical means. In contrast, the less spectacular, though more important, aspects of the technique, the pre-operative correction of the maxillary arch deformity and its relationship with the mandibular arch, have been somewhat overlooked. Those who have been called upon to provide orthodontic treatment for the gross arch deformities which can attend conventional cleft palate treatment will no doubt appreciate the intractability of these conditions.

For some considerable time the pædiatric and plastic surgeons of the Liverpool area had been concerned at the lack of dental follow-up of cleft palate and hare-lip conditions, and as a result of a meeting of all parties concerned it was decided to form a unit to ensure that full and effective treatment was provided. At this time the work of McNeil was known but not understood, and the writer was fortunate enough to be sent to Glasgow, where he was privileged to observe the work which McNeil was undertaking. Following on this it was decided to institute a pilot scheme in the Liverpool area, which has now been in operation for two years. The following represents a brief report of this work, together with certain observations drawn from embryological and morphological findings. It must be emphasized that this is in the nature of an interim report, and very much remains to be done both in the clinical field and in basic science, but that the results have been sufficiently encouraging for the technique to be adopted as a routine procedure.

## EMBRYOLOGICAL FACTORS

Before proceeding to the clinical findings, it is necessary to state as briefly as may be the salient features of the development of the face and palate. Classical theory of the development of the face has postulated the existence of various facial processes which "fuse" during development. Originally, and indeed until relatively recent times, this process of fusion was held to imply ectodermal fusion, as though these processes were individual "fingers" in space which grew together and fused by the destruction of their extodermal covering layer.

Following the work of modern embryologists, notable among whom must be mentioned Streeter (1951) of the Carnegie Institute of Washington, it became realized that the facial processes consisted of mesodermal masses migrating forward between the ectodermal covering of the face and the roof of the oral cavity. In this way no ectodermal fusion is called for, but rather a smoothing-out of ectodermal folds. Following on these observations on normal embryos, Stark (1954) has reviewed the state of knowledge concerning the pathogenesis of hare-lip and cleft palate and has added his own observations based on the study of five hitherto undescribed cleft palate embryos.

Given at the Jubilee Meeting held on May 9, 1958.

Modern theory holds that on the fusion of the neural folds to form the brain, certain cells are extruded from the neural crest and that these cells migrate down the side of the head to form the cranial ganglia and the visceral arches. The experimental evidence supporting this theory has been adduced from work on amphibia, which, having free-living larvæ, are well suited to this approach. This work has been well reviewed by Horstadius (1950). Investigation of the origin and behaviour of the mesoderm in amniotes has had to rest on the examination of close series of histological preparations. Bartelmez and Evans (1926) and Baxter and Boyd (1939) examined the problem in man, while Burston (1953) investigated a very close series of sheep embryos and was able to demonstrate a marked correlation with the experimental findings in lower forms.

The migration of neural-crest cells into the visceral arches takes place at 24–26 days. In so far as the mandibular arch is concerned, a secondary caudal extension of this mesoderm then occurs which pushes round beneath the brain towards the midline, thus forming the maxillary processes. However, on either side of the face there are two residual areas where the ectodermal coverings of the face and that of the roof of the oral cavity (in its most anterior part) remain close together. These areas—the olfactory placodes—are somewhat pear-shaped in outline as seen from the front, with the narrow part extending downwards to involve what will be the lip. Between the two ectodermal layers forming these areas there is only a very thin layer (a few cells thick) of the original mesoderm. As the adjacent mesodermal extension from the mandibular arch (maxillary process) continues to grow, the contour of the face takes on the characteristic bulges of the facial processes and the olfactory placodes appear to sink in to the face. These events have been well described and figured by Streeter (1948 a).

Two points now arise:—

1. It has been stated that the floor of the olfactory pit consists of two layers of ectoderm in close apposition and that the most dependent portion of this area potentially involves the lip.

2. The embryo is growing very rapidly and the main function of the mesoderm at this stage is to provide a vascular supply, since the original process of diffusion of fluids is no longer adequate to sustain the life of the cells in so large a mass.

Hence the whole of the olfactory placode would be in danger of breaking down, were it not for the fact that in normal development a part of each maxillary process passes beneath the main upper portion of the placodes, thereby separating the two layers of ectoderm and forming a bar of tissue which is the primitive palate. The upper portion of the olfactory placodes continues as thin double membranes, which are now known as the bucco-nasal membranes, and these eventually break down to form the two primitive nostrils. (Streeter, 1948 b.)

The formation of the primitive palate is complete by 5 weeks, and from this structure is derived the upper lip and premaxillary region of the maxillary complex as far back as the naso-palatine canals, which for practical purposes may be taken as the region of the incisive foramen.

It follows that should there be a failure of either or both of the maxillary processes to extend beneath the olfactory placodes, the latter split right through to the lip and a hare-lip will result. The actual position and extent of the cleft(s) will, of course, depend on the degree of failure of the mesodermal extension.

It is possible to distinguish, therefore, clefts of the primary palate, which from the clinical standpoint are seen as clefts of the lip, varying from minor notches to an involvement of the nostril. These clefts may be either unilateral or bilateral, and may or may not involve the alveolar process in the incisal region.

Although clefts of the primary palate are frequently associated with clefts of the palate proper, they can and do have an independent existence (*Fig.* 1). They must have occurred before the 5-week period and they are formed by a breakdown process rather than by a failure of fusion.

The formation of the secondary palate, by the fusion of the maxillary palatal processes with each other and with the inferior border

of the nasal septum, is well described in many standard works. Certain points are, however, worthy of emphasis:—

1. The palatal folds emerge at about 8 weeks, that is, very much later in embryological time than the formation of the primitive palate.

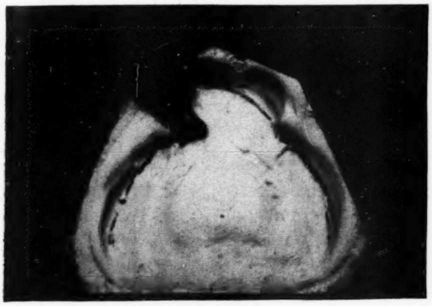


*Fig.* 1.—Total unilateral cleft of primary palate only.

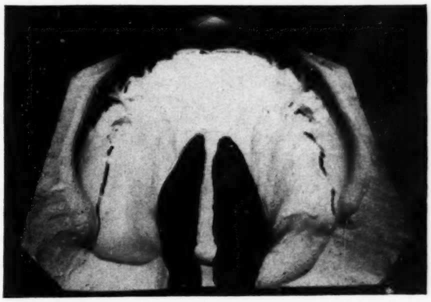


*Fig.* 2.—Total bilateral cleft of secondary palate only.

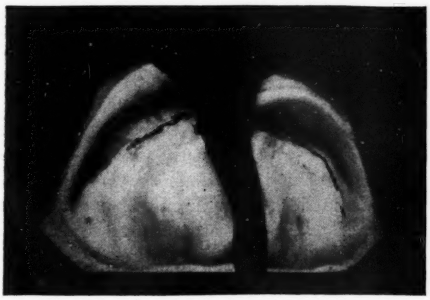


*Fig.* 3.—Total unilateral cleft of primary and secondary palates.

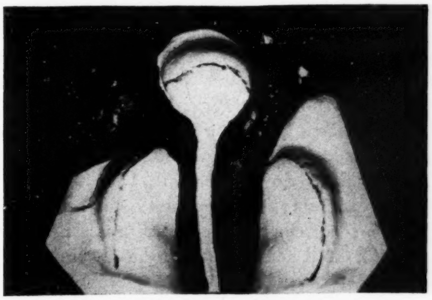


*Fig.* 4.—Total bilateral cleft of primary and secondary palates.

2. These processes are at first vertically disposed on either side of the tongue, but at about 9 weeks, consequent on the descent of the mandible, the folds come to lie above the tongue and fuse from before backwards with the nasal septum, to form most of the hard and also the soft palate.

3. This is a true process of fusion involving the degeneration of the overlying ectoderm. Ectodermal remains may be seen in histological sections for a long time after fusion is complete.

Various factors may arise to interfere with this process, among the most probable of which are:—

1. When the cleft of the secondary palate is associated with a previously occurring cleft of the primary palate, it is reasonable to postulate that there has been a gross interference with the migration and development of the original maxillary process, so that either or

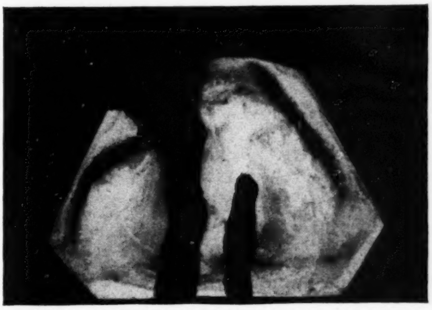


*Fig.* 5.—Total unilateral cleft of primary and secondary palates on the right, sub-total unilateral cleft of the secondary palate on the left.

both of the definitive palatal processes are reduced in size and fail to reach the midline.

2. There may have been a failure of the epithelial coverings of the palatal processes and septum to degenerate and hence prevent mesodermal fusion.

3. There may have been a failure in co-ordination between increase in width of the head as a whole and the development of the palatal process.

4. It is possible, as has been pointed out by Scott (1955), that cyst formation may occur in the degenerating epithelium and that these cysts could break down.

5. In a rather special category is that the failure of the mandible, and hence the tongue, to descend may have prevented the palatal folds coming into apposition. It is felt that this mechanism is probably a principal cause of clefts of the secondary palate only, particularly where these are also associated with micrognathia of the mandible.

*Fig.* 2 illustrates a total bilateral cleft of the secondary palate. Clefts of the primary and secondary palate may combine in various ways as is shown by *Figs.* 3–5.

A consideration of the failure of the mandible to descend involves a prior study of the cranial base. The definitive cranial base is formed from cartilaginous elements which rapidly fuse to form three main structures: the inter-oribital nasal septum; the hypophysial plate; and the parachordal plate surrounding the notochord in what will be the basi-occipital region of the definitive skull (de Beer, 1937). These three elements fuse together, but for some considerable time the sites of union, particularly the posterior one, are very tenuous and but poorly chondrified (Burston, 1953).

Consequent on the precocious development of the brain, the head of the embryo is curled over onto the pericardial region, so that the mandibular arch is trapped between these structures. The angle between the inter-orbital nasal septum and the parachordal plate is almost 90° with the apex at the hypophysis. Owing to further differential growth in the various parts of the brain, this flexion is steadily decreased, the opening taking place at the junction of the parachordal and hypophysial plates in what is termed the posterior basi-cranial fenestra. It is this change in the basi-cranial axis which lifts the head away from the pericardial region and enables the mandible to grow downwards from the cranium. Any failure in this mechanism will be liable not only to produce a cleft of the secondary palate but also to interfere with the normal growth of the mandibular arch, at a time when the primitive skeletal relationships between the jaws are being established.

## LATER MORPHOLOGICAL FINDINGS

It is now necessary to consider the cranial base at a much later stage of development from six months intra-uterine to birth and thereafter. Scott (1953), Kettle (1954), and Glass (1955, 1956) have emphasized the importance of the nasal septum in the development of the maxilla, but so important is this structure to this early orthodontic treatment that it must be considered again at this stage.

The inter-orbital nasal septum in the fœtus, and indeed in the infant up to 2–3 years of age, is an enormous structure, lying almost entirely within the face. A baby has only a small snub nose, yet within the face the septum stretches posteriorly as far as the basi-sphenoid.

Ford (1956) examined a series of fœtal skulls from 10 to 40 weeks, and has shown that the septal region increases six to sevenfold in this period compared with the remainder of the cranial base, increasing by a factor of four to five.

At birth the cartilaginous nasal septum accounts for half the length of the entire cranial base measured from the rostral extremity to the foramen magnum.

Laterally, the nasal septum is in relation with the vertical plate of the maxilla via the nasal cupola, while inferiorly the septum is in direct relation with the maxilla in its anterior part (*Fig.* 6). Any growth of the septum must therefore have a profound effect on the development of the maxilla at this stage, and indeed it is this growth of the nasal septum which is responsible for the separation of the maxilla from the rest of the skull and consequent deposition of bone in the sutures joining the maxilla to the adjacent bones.

An initial survey by X-ray methods of the cranial base of post-mortem specimens shows that this state of affairs persists to about the $2\frac{1}{2}$–3 year period. (*Fig.* 7.) During and after

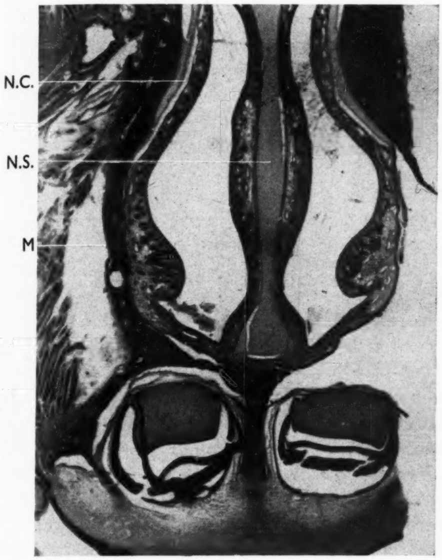



*Fig.* 6.—Frontal section through the nasal region of a full-term human fœtus. Note the relationship of the 'keel' of the nasal septum (N.S.) to the maxilla (M) and the way in which the vertical plate of the maxilla is invading and ossifying the nasal cupola (N.C.).

this time the intra-facial portion of the cartilaginous septum, i.e., the part in association with the maxilla, is gradually replaced by the bone of the mesethmoid from above and also ossified from below from the vomer. The cartilaginous element persists anteriorly and grows on the face to form the definitive nose (*Fig.* 8).

Once the intrafacial part of the septum is ossified, the capacity for separation of the posterior facial suture system (Scott) is of course greatly reduced, and the radiographs shown confirm Scott's analysis that after the age of 3 years the emphasis on maxillary growth is shifted progressively in favour of surface deposition.

It now remains to examine what may happen when Nature performs an experiment in disconnecting either one or both maxillæ from the influence of the nasal septum.

*Fig.* 9 represents schematically the typical deformities that can arise in cases of clefts of

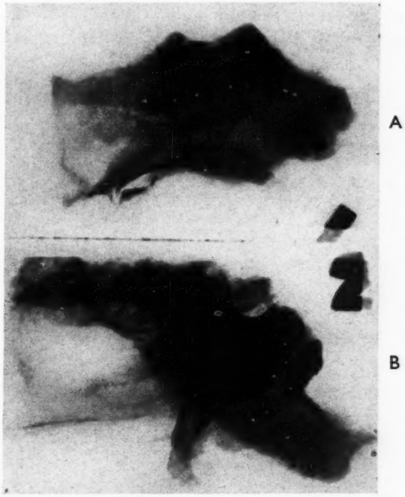



*Fig.* 7.—A, X-ray of the cranial base of still-born human. Note the large cartilaginous area underlying the anterior cranial fossa (the anterior $\frac{1}{8}$th of the septum was left in situ at post-mortem); B, X-ray of the cranial base of a 2-year-old child (post-mortem specimen). The large area of cartilage underlying the anterior cranial fossa is again well seen.

*Fig.* 8.—X-ray of the cranial base of a $4\frac{1}{2}$-year-old child (post-mortem specimen). Note the way in which the intra-facial portion of the septum has been ossified by the mesethmoid and vomer while the cartilaginous portion has grown forward to form the septum of the definitive nose.

the primary and secondary palate. Considering first the unilateral defects, it will be noted that in each case the lesser segment is underdeveloped in an anteroposterior direction.

Type A occurs less commonly and is characterized by a midline deviation of the lesser segment, the major segment being but little disturbed. Type B is much more commonly seen, and here the major segment has deviated to the non-affected side. Again the lesser segment is under-developed and its alinement

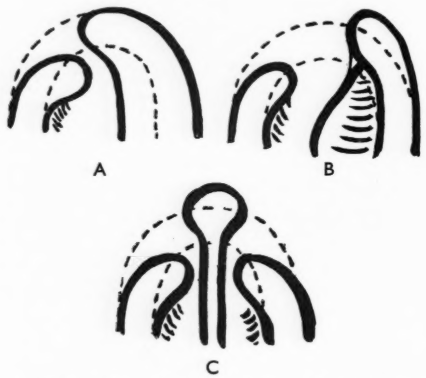



*Fig.* 9.—Schematic representation of the maxillary arch deformities occurring in unilateral and bilateral clefts of the primary and secondary palates. The dotted lines show the presumptive arch form in each case.

with respect to the lower arch would appear to depend on whether or not the tongue has invaded the line of cleft. It is suggested that the failure of the lesser segment to grow forward to its true position is due in large part to its being denied the growth impulse of the nasal septum proper. The nasal cupola is comprised of very thin cartilage and in consequence fails to bring the maxilla forward once this is separated from the keel of the nasal septum. These cases are marked by a very stretched and tense ala of the nose on the affected side, and if this condition is allowed to persist, may materially lessen the chances of the surgeon producing an æsthetically acceptable nostril at lip closure (*Fig.* 14 A).

The bilateral condition (*Fig.* 9, Type C) is characterized by two retroplaced and small maxillæ. Very frequently this condition is also associated with a certain degree of micrognathia of the mandible. The central stem carrying the premaxilla is *relatively* protrusive. It should be noted that although this latter element may be somewhat rotated in an upward direction, the actual amount of true over-development is often quite limited and the major defect lies in the retro-placed maxillæ.

The normal surgical procedure for unilateral defects appears to be to wait for some three months before attempting primary lip closure. The reason for this is that once the immediate neonatal period is passed, and with it the protection conferred by the maternal antibodies, it is necessary to wait until the infant has become stabilized to independent existence before operating. Three months' delay has been found the best compromise between the general condition of the patient together with the convenience of increased size of the lips as against the progressive deformity which often occurs with delay. Attempts have been made to operate in the immediate neonatal period in order to minimize the deformity, but this procedure has not so far been generally accepted.

Various techniques have been advocated for lip closure, but for the purpose of this paper these may be divided into those that undertake closure of the anterior palate at the time of lip operation, and those that confine attention to lip closure only.

Whichever technique is followed, the lip has to be closed over a considerable defect in the alveolar arch, and this repair, together with the Logan bow (which is applied to relieve the sutures of tension), inevitably results in some collapse of the alveolar segments. In cases where the pre-operative position of the segments chanced to be favourable, the skill and artistry of the surgeon might well produce a very acceptable maxillary arch in good relation with that of the mandible. Much more commonly, in the writer's experience, has been the collapse of the maxillary segments to greater or lesser degree dependent on the original position of the fragments (*Fig.* 10).

The McNeil technique affords a means of correcting this mal-position pre-operatively, and hence gives the surgeon a firm foundation around which to reconstruct the lip and also make æsthetically acceptable nares.

In the bilateral clefts of lip and palate two main surgical approaches have been adopted. Both techniques recognize the progressive nature of this deformity and both undertake the first operation at about the 6-week period, accepting the risks of operating at this age in the interests of relieving this gross deformity.

*Fig.* 10.—Typical collapsed maxillary arch following unassisted surgery in a case of total unilateral cleft of the primary and secondary palates.

The first technique, used by those closing the anterior palate at the time of lip operation, consists in closing first one side at the 6-week period. The case is thus converted into a unilateral defect, often with marked deflection of the septum and nose towards the repaired side. At the 3-month stage the other side is then closed. The object is to use the reconstituted lip to prevent further discrepancy between the central stem and the lateral maxillary segments. The difficulties arising are the large depressions left in the alveolar margin between the premaxillary and maxillary segments together with the almost inevitable ensuing midline collapse of the lateral segments.

The second technique, as exemplified by the Denis Browne operation, reduces the premaxillary protrusion at a preliminary operation. This is achieved by resecting part of the vomeral bone and nasal septum, thus allowing the premaxilla to be pushed back, and sometimes rotated, to fit between the lateral segments of the maxilla, where it is fixed by a metal splint. Lip repair is undertaken at a second operation.

The disadvantage of this technique is that it sets back the premaxilla to the maxillary segments which are already retro-placed, consequent on under-development. It therefore follows that in subsequent development the upper jaw remains small, the mandible continues to grow, and the child presents with a "depressed middle third" of the face, the discrepancy tending to increase throughout the growing period (*Fig.* 11).

*Fig.* 11.—Profile of a 9-year-old child who suffered from a bilateral total cleft of primary and secondary palates and for whom a "push-back" operation of the premaxilla was performed.

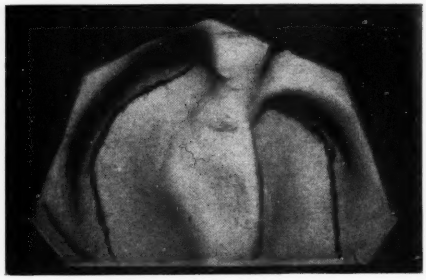
Unhappily, at the time of the push-back operation, the mandible itself may be somewhat retro-placed, so that arch alinement and arch relationship both appear ideal. It is only later when the mandible continues to grow normally that the discrepancy becomes apparent. Further, not only may the premaxilla be pushed back beyond its proper position, but surgical interference to the septum inhibits the all-important growth-centre referred to previously.

The writer is not suggesting that all push-back operations must necessarily deteriorate to a marked degree, for where the original defect was relatively small, surgical reduction

will likewise be small and the resulting deformity will be minimal. Nevertheless, experience of follow-up of many of these cases has shown that "the depressed middle third" of the face is a characteristic feature.

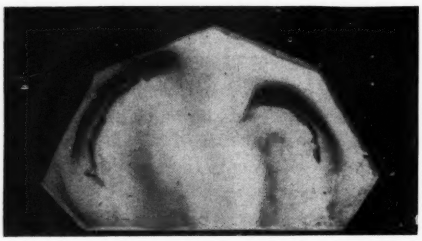
Once again, early orthodontic treatment aimed at limiting further precocious development of the central stem, but more particularly

A



B

*Fig.* 12.—A, Model of the maxillary arch of a very wide total unilateral cleft of primary and secondary palates at birth. B, Model of the same baby at 4 months showing the optimum pre-operative reduction obtained. Any further reduction (as by extra oral strapping) would have brought the line of the maxillary arch within that of the mandible. It is suggested that there is gross deficiency of tissue in this case, and that the appropriate surgical treatment would be closure of the anterior palate at the time of lip operation, the orthodontic aim being to maintain the maxillary segments in good relationship to the mandible. The resultant notch in the alveolar border will eventually be masked by a suitable denture.



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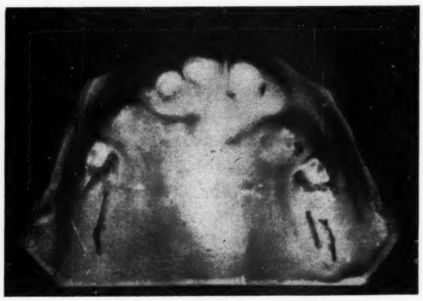


B

*Fig.* 13.—A, Model of the maxillary arch at birth. B, Model of the same child at 18 months following orthodontic treatment. The maxillary arch is in good relationship with that of the mandible. Lip operation was performed at 4 months and the palate has recently been closed.

bringing the maxillæ forward pre-operatively, does yield marked benefits in the treatment of these conditions (*Fig.* 17).

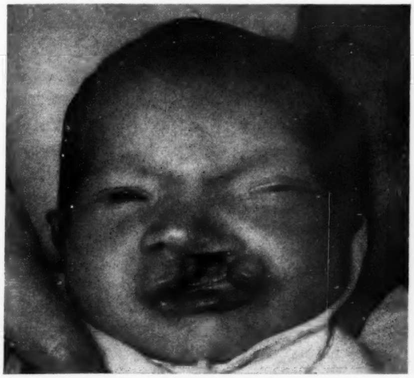
The McNeil technique involves commencing treatment as soon after birth as possible. Experience has shown that treatment in milder cases may be deferred up to six weeks, but on the whole "the earlier the better" is the guiding principle. This has the merit of providing the child with a roof to its mouth, and hence greatly facilitates the feeding problem in the neonatal period.

McNeil has already described the actual details of the construction of the plates used in this early orthodontic therapy and the writer has substantially followed the same technique. It will be recalled that a composition impression is taken of the upper dental arch and a plaster model prepared. The arch deformity and arch relationship to the lower jaw and rest of the skull are analysed by a consideration of the factors discussed above.

From this analysis it is decided what corrective measures are required, e.g., if the

lesser segments needs moving forward and/or outwards, or whether midline correction of the major segment is necessary. The model is

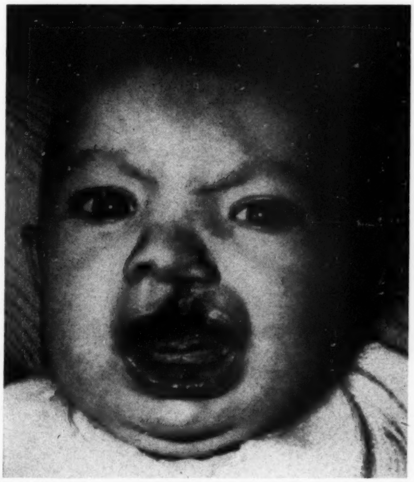
child. It follows that in the early stages, little or no correction may be made, so that the first plate is largely a feeding plate to accustom the baby to wearing a plate. Increasing correction may be applied when the child has passed through the neonatal period and has entered



A

B

*Fig.* 14.—A, Frontal view of infant at birth suffering from a total unilateral cleft of primary and secondary palates on the left side. Note the deflection of the midline of the nose and maxillary arch to the non-affected side. The left ala of the nose is tense and the flattening of the left side of the maxilla can be seen. B, Model of the maxillary arch of the same baby.



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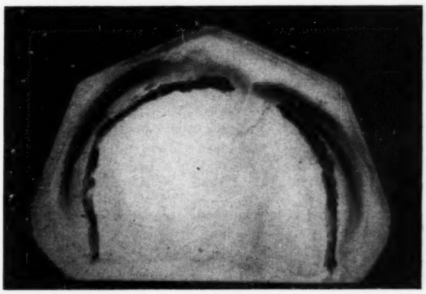


B

*Fig.* 15.—A, The same infant as *Fig.* 14 following orthodontic treatment. Note the closure of the alveolar defect and the reduction in the asymmetry of the middle third of the face. In repose the margins of the lip are in contact. B, Model of the maxillary arch showing the pre-operative reduction achieved. There was clinical "union" in the anterior palate region in this case.

then cut at the appropriate places and the segments moved in the required direction, after which the model is re-based. The actual amount of correction applied at any one time is a matter of clinical judgement, but it is of course related to the rate of growth of the

the phase of rapid growth (4–6 weeks and onwards).

A bite-block is made in soft carding wax to the corrected model and the infant's bite is registered in a slightly gagged position. At the time of taking the bite, the centre line of the

head as a whole is recorded in the wax—this is of great help in trimming the record models and in assessing the deviation of the parts.

A simple acrylic arch alinement plate is then made on the corrected model. From what has been said, it will be apparent that this plate

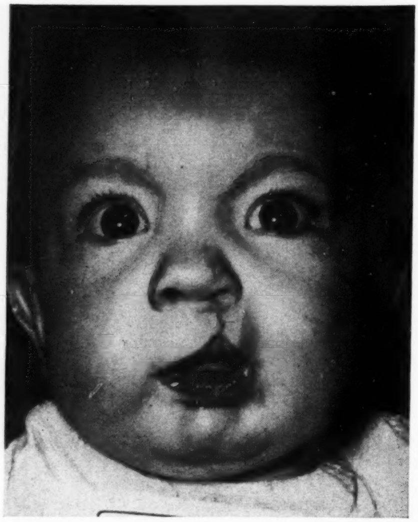
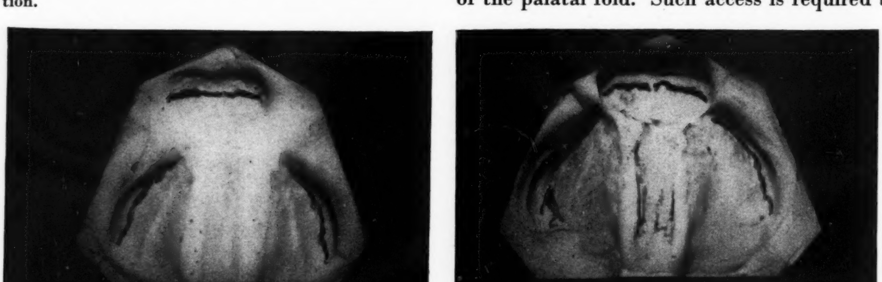


*Fig.* 16.—The same child following lip repair. Note especially the symmetry of the face and the excellent balance of the nose. The red margin of the lip will be dealt with at a subsequent operation.

The internal action of the plate may be reinforced by external elastic strapping where necessary. This is nearly always called for in bilateral conditions, but may also be used to correct a deviated centre line in unilateral cases. Care has to be exercised that the action of the strapping and that of the plate are not mutually antagonistic.

The amount of correction obtainable or desirable in any given case depends on the extent of the original deformity and on the technique of the individual surgeon. Where there has been a gross reduction in the size of the parts, it may well be impossible to secure arch alinement and at the same time preserve a correct arch relationship with the mandible (*Fig.* 12). On the whole, however, complete pre-operative arch alinement, and at the same time acceptable arch relationship, is obtainable in the majority of cases.

Regarding surgical technique in relation to the pre-operative arch alinement, a distinction has to be made between those procedures aimed at closing the lip and anterior palate on the one hand and those closing the lip only. In the former case, full pre-operative reduction of the alveolar defect would prevent the surgeon gaining access to the mucoperichondrium covering the side of the nasal septum and to the mucoperiosteum of the nasal surface of the palatal fold. Such access is required to



A B

*Fig.* 17.—A, Model of the maxillary arch in a bilateral total cleft of primary and secondary palate. B, Model of the maxillary arch of the same child showing the pre-operative reduction obtained.

is not an accurate fit in the infant's mouth and it is the action of "biting the plate" that achieves the desired moulding and stimulation of the maxillary processes.

raise the two flaps required to form the floor of the nose and at the same time constitute the repair of the anterior palate. Hence, in these cases a compromise in arch alinement is sought

and an endeavour made to position the segments so that the resulting post-operative collapse will produce an acceptable arch in good relationship with the mandible.

In those surgical techniques which do not attempt to close the anterior palate at lip operation it is necessary to ensure firm apposition of the alveolar segments (i.e., complete closure of the defect) and ideally this should be obtained prior to lip operation. The reason for this is that it will not be possible to close an anterior defect at the subsequent palate operation because a flap, such as the Veau flap, cannot be brought far enough forward. This raises the question of what has happened in such lip closures before early orthodontic therapy was undertaken. It is a matter of common observation that in, say, the Denis Browne type of operation, a residual alveolar cleft is by no means a constant finding. On the contrary the usual picture appears to be that of a collapsed arch, but one having firm "clinical" union in the anterior region. It is suggested that this "union" must have been brought about by continued firm apposition in the same way as it occurs in embryological fusion. It is thought to be a pressure necrosis of the overlying epithelium brought about by the continuing pressure.

The benefits conferred by orthodontic therapy are therefore to bring forward the underdeveloped segments, and to correct any lateral deviation that may be present, by a process of controlled collapse and moulding of the arch segments. In this way the surgeon has a firm foundation around which to mould the lip, and the resulting growth processes will take place along more normal lines, e.g., the nasal septum will be able to play its proper role.

Clearly there will be those cases where there is such a gross deficiency of tissue that pre-operative treatment cannot fully reduce the defect and at the same time produce a large enough arch for good relation with the mandible (*Fig.* 12). This type of case calls for a surgical technique which closes the anterior palate at the time of operation. The result is that the alveolar segments remain in good relation with the mandible, but there remains a notch in the alveolar border requiring a prosthesis at a later date.

Following lip closure, plates are inserted to maintain arch alinement and to stimulate the growth of the palatal processes. The McNeil type of sprung activator has been used for this purpose. The rationale behind this is the well-known principle that if the blood-supply to growing tissue can be increased hypertrophy is likely to occur. In the writer's experience, the gap in the hard palate does reduce considerably prior to secondary palate closure, and in many cases apposition of the palatal folds with the central stem has occurred. The maximum amount of fusion that the writer can claim is about one-third the total length of the hard palate. In the interests of speech, it has not been deemed worthwhile deferring closure of the palate beyond the 12–18-month period in the interests of securing further "non-surgical" union. The close apposition of the palatal folds does, of course, mean that the surgeon can concentrate on pushing back the soft palate rather than closing a wide lateral defect.

Internal support is maintained until the deciduous teeth are in occlusion. Time alone will show how well the arch relationships will be maintained, but the results so far are encouraging and the surgeons are convinced that the therapy helps their lip and nose repair.

*Figs.* 13–17 illustrate results obtained by early orthodontic treatment.

Some mention may be made of the administrative arrangements under which the work has been carried out.

Ideally an infant is seen as soon as possible after birth and treatment is commenced in the maternity hospital, or if the infant was born at home it is transferred to hospital. The child is accustomed to the plate and feeding difficulties are overcome, after which the child is discharged home, providing domestic conditions are satisfactory. Treatment then proceeds on a domiciliary basis until the child is ready for lip operation, or it is deemed fit to attend as an out-patient.

Where the home is too remote or otherwise unsatisfactory, the infant is usually admitted

to hospital for the whole of the pre-lip operative treatment, or alternatively, where the defect is not great, may be brought in for a shorter but more intensive course of treatment.

Following lip closure the child is kept in hospital for a short time to acclimatize it to the new plate, and is then discharged home. Further treatment is continued on an out-patient basis until the time of palate closure and during the subsequent follow-up period.

A recent advance is the provision of a special ward in a babies' hospital which is reserved for these cases and where the nursing staff can be trained in the handling of these conditions.

In this way, also, special precautions can be taken against cross-infection of these babies, an ever-present danger in larger children's wards.

**Acknowledgements.**—It is a great pleasure to acknowledge the kind courtesy of Dr. Kerr McNeil, Glasgow Dental Hospital and School, who so generously made available to me the benefits of his experience in this work, of which he was the pioneer.

I am also greatly indebted to the medical and nursing staffs of the Liverpool Children's Hospitals for their fullest co-operation and help; especially am I indebted to Miss Isobella Forshall and Mr. Rowland P. Osborne, the senior consultant pædiatric and plastic surgeons respectively, with whom I have been privileged to work, and who have accorded me every facility and encouragement.

I should also like to thank Dr. F. Hudson, consultant pædiatrician, Liverpool Regional Hospital Board, not only for the ward which he placed at my disposal, but also for medical cover and advice in the treatment of these children during their stay in that ward.

I also wish to acknowledge the freedom granted me by the Liverpool University to undertake this work, especially in the persons of Professors H. H. Stones and F. E. Lawton, immediate past and present Directors of the Dental School.

REFERENCES

Bartelmez, G. W., and Evans, H. M. (1926), *Contr. Embryol. Carneg. Instn*, No. 85, 1.
Baxter, J. S., and Boyd, J. D. (1939), *J. Anat. (Lond.)*, **73**, 318.
Burston, W. R. (1953), Ph.D. thesis, University of Cambridge.
de Beer, Sir G. R. (1937), *The Development of the Vertebrate Skull.* London: Oxford University Press.
Ford, E. H. R. (1956), *J. Anat. (Lond.)*, **90.**
Glass, D. F. (1955), *Trans. europ. orthod. Soc.*
— — (1956), *Ibid.*
Horstadius, S. (1950), *The Neural Crest.* London: Oxford University Press.
Kettle, M. A. (1954), *Dent. Practit.*, **5**, 70.
McNeil, C. Kerr (1954), *Oral and Facial Deformity.* London: Pitman.
Scott, J. H. (1953), *Brit. dent. J.*, **95**, 37.
— — (1955), *Ibid.*, **98**, 109.
Stark, R. B. (1954), *Plast. reconstr. Surg.*, **13**, 1.
Streeter, G. L. (1948 a), *Contr. Embryol. Carneg. Instn*, **31**, 172.
— — (1948 b), *Ibid.*, **32**, 190.
— — (1951), "Developmental Horizons in Human Embryos", Embryology Reprint, Vol. II, Carnegie Institution of Washington.

## *DISCUSSION*

*Mr. M. A. Kettle*, in opening the discussion, said he thought Dr. Burston had to be congratulated most heartily on the way in which he had presented his paper, and he thought everyone would feel better for the fact that one as energetic and as keen as Dr. Burston was pursuing the problem of the cleft palate.

The problem of the cleft palate was one which was staring all orthodontists in the face, and he thought they should all do more about it.

Mr. Kettle said he would like to open the discussion more from the clinical angle, although Dr. Burston had gone into the embryology of the subject in some detail.

The use of the technique which had been described, the repositioning of the segments of the upper arch, was something which obviously had to be accepted as a method which had in some cases a very definite and practical application. In the case of the bilateral cleft of the lip and palate the surgeon was faced with a great problem, and one could quite see why the pre-vomerine section was often removed with such disastrous results in the past. On the other hand, modern surgeons —and surgery has undergone a tremendous change in ten years—do not do that, but tend to stretch the lip over the prolabium. In those cases there would be a very distinct advantage in moving the prolabium back into a better position so that the surgeon could have a very much better subject to work on. He would be a little more hesitant in suggesting that the benefits would be quite as great in the unilateral type. One big problem was that as the child grows the depression in the middle third of the face persists. Everything that could be done to promote and encourage the forward growth or forward positioning of the anterior part of the maxillary arch should be done, because that would be doing a great service to the patient, holding the upper lip forwards and giving the patient a very much better facial contour and profile.

In the unilateral type, where the segments were repositioned prior to operation, there would obviously be a backwards movement of the anterior part of the larger segment. It would be seen that that was the only way to bring the two together, which meant that when the surgeon operated on the lip (although he would have a slightly easier task in moulding the lip on to the newly positioned upper arch) he would be working down to a depressed bone segment and the lip would clearly be too far back already.

Mr. Kettle said he would not dream of criticizing anything Dr. Burston had said, because he felt that anything done to help children with cleft palates was good, but he thought that in every case Dr. Burston had shown post-operatively the upper lip was definitely set back in relation to the rest of the face. They all had a look about them which he did not like, especially in the immediate post-operative period. He had seen many children post-operatively whose upper lip seemed to be projecting too far forwards, but that did not last very long. The relative apportionment of growth as the lower jaw came down and the rest of the face built round it meant that the prominence of the upper lip decreased very rapidly. Even in early adult life one was worried about the fact that the lip was set in rather too far but one never worried if it was set too far forwards. That was the biggest point he had to make against the method which had been described. He would much prefer some means of holding the anterior part of the upper arch forwards rather than have it moved inwards.

The immediate effect of the lip operation was to cause a collapse of the segments, but where the lip operation was successful it gave the patient an active, mobile, upper lip. In this type the greater collapse was in the region of the lesser segment, and that in itself had the desirable effect of holding the anterior part of the greater segment forwards. In the unsuccessful operation where the lip was either tight, thick, or immobile, one found the greater inward movement taking place on the anterior part of the larger segment, giving a result very much like the ones that had been shown after repositioning. It was for that reason that Mr. Kettle was a little worried about the method, because the patients who at the age of 6 looked slightly pre-normal changed to children who looked markedly pre-normal later on.

The greatest benefit, he had found, was derived in encouraging the forwards drift of the upper arch at 6 or 7 years of age. At that stage the use of the occipitomental anchorage tended to encourage the upper arch forwards and also to change its buccolingual relationship with the lower arch. By this means a normal buccolingual relationship of the cheek teeth could be produced without any lateral expansion of the upper arch.

The only other thing Mr. Kettle did not like about the method described was that in using an appliance from the very early stages, one was committed to retention plates over a long period of time. Cleft palate patients are very prone to caries, and to them the loss of a tooth was a very vital thing, particularly if it came from the line of the cleft. Therefore, if one was submitting a patient to plates from the early stage and reckoning on continuing through with some sort of retention plate, one was obviously inviting the onset of more and more caries, with disastrous results.

Mr. Kettle said that after all that criticism he wanted to thank Dr. Burston very much; he was not really criticizing, but trying to extend another point of view so that more people would join in the discussion.

*Dr. Burston* thanked Mr. Kettle and said he was afraid he did go through the details of the technique regarding the treatment of the unilateral type of case too quickly. He entirely agreed with Mr. Kettle as to the futility of trying to push back the larger segment; that was something he had tried to suggest was *not* done in the techniques he had described. In this technique they were trying to bring the lesser segment forwards. He drew an illustration on the board showing that if the septum was deviated and, with it, the larger segment displaced laterally all that was attempted was to correct this deflexion, the action of the plate being reinforced by extra-oral strapping as the last resort.

He agreed that the action of the plate and strapping would, if wrongly used, be mutually antagonistic. What was done was to concentrate on bringing forwards the lesser segment, which was probably assisted by the tongue thrust into the plate, at the same time moulding the larger segment by suitable corrections applied to the plate. If this failed completely to reduce the deviation of the larger segment, then extra-oral strapping was used, together with a plate designed to maintain the lesser segment in good position while the anterior portion of the larger segment was moulded into the plate by external pressure.

Because he had not wished to speak for too long he had not mentioned an attempt they were making to record arch relationships in these infants. Briefly, it consisted of obtaining models of the maxilla and mandible and articulating these with the aid of a bite taken in the "rest position", i.e., the baby chewed the bite to a position of comfort. Wires were then adapted to the crest lines of the dental arches and a sheet of soft wax inserted between the articulated models. The articulator was then closed and the wires pressed into the wax. The sheet of wax with the embedded wires was then radiographed and gave a graphic illustration of the antero-posterior and lateral relationships of the maxillary segments with respect to the mandibular arch.

With regard to caries, Dr. Burston agreed that the preservation of the teeth was vital to these children. An organization existed whereby the children were followed-up at 3-monthly intervals after this early treatment had been concluded for this very purpose. It was not always easy because the social background of some of the parents was such that it was almost impossible to contend with home conditions.

Dr. Burston and others who believed acidity was an important factor in caries advised the use of magnesia on the fitting surface of these plates to try to combat decay, and on the whole this appeared to be effective.

Regarding retention of the maxillary segments it would take a few years before they could really judge the results. However, at present they tried to maintain the arch relationship until the deciduous teeth were in occlusion.

On the whole Dr. Burston considered the technique had generally minimized the gross deformations occurring to the maxilla that so frequently followed unassisted surgery. Even in the worst cases he thought the treatment brought the child within the range of normal orthodontic procedures.

*The Chairman* opened the topic for general discussion.

*Mr. D. Greer-Walker* said he had known Dr. Burston's work for many years, and he wanted to compliment Dr. Burston on that work, and upon the fact that he had tried to tackle the problem from a basic scientific angle.

With regard to Dr. Burston's point of the failure of the lesser segment and the over-development of the premaxilla, one often heard people mention the word "collapse" after any operative procedure. This was erroneous in a sense because what Dr. Burston had put forward had to be viewed from a slightly different angle, namely the growth potential and the related potentials of the different parts.

In his work on gross deformities, Mr. Greer-Walker had always found it extremely difficult to analyse what was really the primary deformity and what was a secondary change in that primary deformity. He could give a good example from his work on hypertelorism where, basically, there was a first arch failure, a failure chiefly in the maxillary process and the offshoot of the maxillary process which formed the lateral wall of the middle fossa. What one found there was the failure of the maxillary process causing a strain upon the nasal process.

When one saw cleft palate deformities, it was necessary to bear in mind that owing to the separation of the maxilla from the premaxilla the sequence of potentials of growth was very greatly upset, and that was why he would differ slightly from Mr. Kettle. One could argue that the premaxilla was free to go in its primitive direction. What Dr. Burston might be doing was to a certain extent placing the premaxilla back where it might more rightly belong.

In thinking of clefts it was important to think of the question of the growth impetus, realizing that clefts could occur in any type of cranial facial morphology. So often people looked at a cleft and said, "Here is a Class 3". The surgeon was blamed, but it may well be that that patient might have been a Class 3 irrespective of the cleft.

The treatment was extremely important at this early stage, and so valuable on account of growing bone. Everyone knew that with conditions such as the Pierre Robin syndrome, the intra-uterine malformations along with talipes were postural defects, and when a child was born one found a return to the original form. One can assume at this early age there is the plasticity present which would allow some readjustment to take place.

It had been a great pleasure to listen to such a very valuable contribution as that made by Dr. Burston, and Mr. Greer-Walker said he wanted to thank Dr. Burston very much.

*Dr. Burston* thanked Mr. Greer-Walker and said he was very much indebted to him for many acts of kindness and help in the study of the conditions he had mentioned and related conditions.

Terms such as "collapse" were descriptive. If they were going to be more than descriptive terms, there would thereby be the imputation that the whole secret of the embryological process was known. One talked about growth potential, but to Dr. Burston that was getting very near to saying the secret of life itself. In embryology one could observe the fact that an embryo goes through certain stages which could be recognized under a microscope, but it did not explain how it reached one stage from another or yet the vital property of neural crest material; it did not explain how from the crest it turned into, say, the mandibular arch and the maxillary process extending over the roof of the oral cavity to form the two condensations in which the nasal septum would develop. How these processes took place was not known, but they were implicit to life itself. One was on very difficult ground when one started to argue about such things, because it was so easy to develop to the level of metaphysical argument, and that was an extremely difficult topic.

Dr. Burston had tried to use descriptive terms in their common usage, but of course he did not know why a cleft palate occurred. From analysing it he could say when a cleft must have occurred in the development, but that was a long way from describing how it occurred. Therefore, he would not like to stray into the question of growth potential, important as it was, for it brought in the question of genetics and opened up a very wide topic.

*Mr. D. F. Glass* said that anyone who has heard the earlier discussions on the subject would realize how much everyone disagreed on all the points. Not only was there disagreement among orthodontists but the plastic surgeons were sceptical about the claims made by orthodontists.

Dr. Burston had presented a very good paper, although there were some points with which Mr. Glass did not agree. He was pleased that Dr. Burston did not claim that he had obtained calcified union across the cleft. The plastic surgeons thought the orthodontists were saying they got ossification across the cleft, and until this could be definitely proved, no wild claims should be made. Mr. Glass was pleased that Dr. Burston had been reserved in his statements.

Having seen some of the cases who had been treated in the manner described by Dr. Burston, he thought the tissue produced across the clefts or towards the clefts was not good. It has the appearance of the tissue one found under a lower denture that did not fit. What was Dr. Burston's opinion of this tissue!

Mr. Glass did not understand how the segments of the maxilla could be moved forwards. These segments are attached to the pterygoid plate or the sphenoid, and any movement must be a swinging action in an outward or inward direction with the fulcrum at the pterygomaxillary suture.

It was fashionable to follow the trend of orthodontics of the period, and the idea that the pre-vomerine resection was wrong had arisen. Mr. Glass was not prepared to say whether it was right or wrong, but before it could be condemned out of hand the work of Cronin should be considered, because he had obtained some very good results by a very special technique done by expert plastic surgery.

Mr. Glass did not agree with Mr. Kettle on some of his ideas, and he thought the whole problem was very involved. He preferred to treat the patients later. The idea of swinging out the lesser segment was right, but he considered it should not be done before 3 or 4 years of age; if segments could be alined in 3 to 6 months, surely that was better done when the teeth were present. It was not a matter of orthodontics but of dental orthopædics.

Mr. Glass said he hoped to be able to talk to Dr. Burston later, and he said it would not be necessary to reply to his question immediately.

*Dr. Burston* rather gathered that Mr. Glass was criticizing him for something he had not said, and he (Mr. Glass) was almost sorry he had not said it. All he was prepared to say was that he had given an interpretation as seen by one individual.

With regard to the clinical "union", it was solid; if one pressed upon it with a ball-ended spatula it would not move. He would not be prepared to say what it was until some plastic surgeon trephined the area, but he

would not ask a plastic surgeon to trephine a baby just to have the satisfaction of knowing. The Germans had done that, and he understood that McNeil had histological evidence. His own evidence was hearsay and he would not pass it on until he had seen it himself. Of course there was no fundamental objection from an embryological point of view, and that was why when he had asked to see McNeil at work, he had approached him with an open mind. He did not regard the technique as a panacea of all cleft palate troubles, but thought it a valuable adjunct to surgery.

In reply to a question by Dr. Burston, Mr. Glass said he had not been talking about the lesser segment of the premaxilla when on the topic of pushing the maxilla forwards but the lesser segment of the cleft.

Dr. Burston said a cleft could be regarded as Nature's experiment. Dr. Scott had given several very elegant analyses of the method of growth in the skull, and everything that took place in the cleft fitted that pattern, so one could look at the cleft palate side of it as Nature's experiment and proof of what Dr. Scott had worked out in another way.

On the question of the resection of the vomer and septum and push-back of the premaxilla, he had seen conditions in which the surgeon, with the greatest skill, had assessed the slight degree of over-development of the central stem and been prepared to settle for a reduction at the time of the first operation, and the final result had been extremely desirable. There was, however, no scientific method by which to assess it at the time of operation. Many resections of the septum had produced a depressed mid-third of the face. To him the whole essence of development was balance, the cartilage, neural tissue, membrane, and bone all working together in a state of balance, and anything that interfered with that balance was bad, and anything that could be done to restore balance, however imperfect, was good. He regarded the technique as a harnessing of the membrane bone back to the influence of the cartilage of the septum and the strapping, where used, as an artificial substitute to correct soft-tissue action while awaiting lip repair.

*Mr. J. C. Ritchie* congratulated Dr. Burston on his communication and agreed with almost everything he had said.

Having carried out such work for four years, there were one or two things he had learned. First of all, in the very early days, in many cases one was dealing with a rather poor specimen. It had been his experience that a child who was fitted with an appliance to enable it to suck at a very early age derived a tremendous advantage. The technique was usually to take an impression at two days old and to fit a simple base-plate with bite-block attached in correct occlusion for sucking purposes at three days old, so that the moulding of the alveolus could be done more or less at one's leisure. In this respect he had found it advantageous to do the moulding in at least two and possibly three stages; he did not believe collapse would take place if the moulding was done gradually. It was unnecessary for an appliance to be worn after a lip operation, apart from the few days immediately following the operation.

In his experience the moulded segments had stayed together extremely well and had shown no deterioration after the teeth had erupted.

*Dr. Burston* thanked Mr. Ritchie and explained that as McNeil had already published his findings on his clinical method he had not thought it necessary to stress the fact that they did proceed, as Mr. Ritchie said he did, in several stages, the amount of correction put on each time being related to the growth rate of the child. Initially, before growth was taking place, they used an almost uncorrected plate to get the child acclimatized to a plate and to get it feeding. The nursing staff and the pædiatric surgeons were very appreciative of such a plate because it enabled the child to suck, the only proviso being that a teat with a slightly larger hole should be used so that the child would not become too tired too quickly.

With regard to collapse, one had to be careful after a lip operation. Where one did succeed in getting the "union" across the alveolar segment it appeared to be self-maintaining, but he had one case which had lined up very nicely and about which he had been very happy, but he did not maintain it long enough and he found the trouble recurring; it was in the case of a surgeon who did not close the anterior palate at the time of operation. The lip was very loose following operation, hence the two maxillary fragments were not held in close contact so that "union" might occur. He had subsequently overcome this difficulty by the use of suitable plates and extra-oral strapping and the result now appeared stable (i.e., 12 months after operation).

*Mr. J. H. Hovell* thought it was extremely interesting to see how the workers on cleft palate orthodontics were following so closely the idea and theories that were put forward by the workers on general orthodontics when orthodontics first became a speciality. Angle, at his school, had said that by doing orthodontics early the child was enabled to reach growth potential. That had all gone by the board; all the extravagant claims of the past had been disproved. These claimants harmed orthodontics by claiming too much—supermen who changed genetics.

Mr. Hovell thought something of that nature was taking place now in early cleft palate orthodontics. He thought that some workers on cleft palate orthodontics were trying to claim too much for changes which in fact they could not produce, and that they were doing their speciality harm by claiming too much.

The work Dr. Burston himself was doing was very valuable work, but its main value was in controlling the plastic surgeon and giving him a better basis on which to work, so that he would not do unnecessarily mutilating operations on the lips and premaxilla. He hoped Dr. Burston would carry on with his work and would improve upon it, but suggested that too much should not be claimed for it.

*Dr. Burston* said he had been at great pains to avoid claiming too much for the work. He emphasized that he had no ulterior motive, that it was not his work, it was McNeil's work. Anything he had said he would take full responsibility for saying, but when McNeil first put over the work there was a storm of controversy about it, although it seemed to Dr. Burston that the basis of the technique was eminently right from the embryological and morphological standpoints. The technique merely harnesses together tissues which have become separated.

He himself had only been doing the work for three years, but he had the background of people who had given a substantial part of their lives to treatment of these conditions, such as the two surgeons with whom he said he had had the privilege to work, and they were satisfied that from the clinical point of view they wanted the technique. Much work remained to be done in the laboratory, but in the first instance the test had to be

in the clinical sphere. He had been asked to go and try the technique, and that was all he had done. Those who had been working on it and who had vastly more experience of it were satisfied that it was conferring benefits on the children. That was as far as he was prepared to go in making claims. All they were doing was giving the surgeons a better chance to develop their art, and that was all he would claim for it.

*The Chairman* said that Dr. Burston had kept a very difficult subject in complete perspective. He thanked him for what he could only describe as a *tour de force* and said how envious he was of anyone who knew his subject so well that he could talk around slides without effort.

Mr. Kettle had spoken of Dr. Burston's energy and enthusiasm which he (the Chairman) knew from his own experience extended to the cutting of all sections; to worrying other hospitals and departments for specimens; and collecting them all himself. He felt sure the work was of fundamental value and had a bearing not only on cleft palate problems but on general problems of growth and development.

The Chairman thanked Dr. Burston for his paper and Mr. Kettle for opening the discussion.

# ABSTRACTS FROM OTHER JOURNALS

### Swellings of the Jaw

A most confusing variety of tumours occur in the mandible and the maxilla, including the neoplasia arising in the soft tissues within the bone and in the epithelial and connective-tissue derivatives of developing teeth.

The frequent reactive and dysplastic processes in these regions frequently obscure the picture still further; therefore a classification such as the following is recommended by the authors:—

*A. Tumours arising from the tissues of the developing teeth*: (1) Dental cyst; (2) Dentigerous cyst; (3) Fibrous odontome, e.g., cementoma and dentinoma; (4) Composite odontome; (5) Adamantinoma.

*B. Tumours arising from the skeletal tissues*: (1) Bony: (*a*) osteoma, (*b*) osteosarcoma; (2) Cartilaginous tumours: (*a*) chondroma, (*b*) chondrosarcoma; (3) Giant-cell tumour.

*C. Tumours arising from the soft tissues within bone*: (1) Fibrous tissue: (*a*) fibroma, (*b*) ossifying fibroma, (*c*) fibrosarcoma; (2) Blood-vessels—hæmangioma; (3) Nerve tissue; (*a*) neurofibroma, (*b*) neurinoma, (*c*) neurofibrosarcoma; (4) Marrow cells: (*a*) myeloma, (*b*) Ewing's tumour, (*c*) reticulum-cell sarcoma.

From the text it appears that although in most instances it is permissible to assign these jaw tumours to a proper classification, there are many examples where the real nature is in doubt although much is known of their behaviour.

With regard to the unclassified tumour, the histological appearances are characteristic and render this tumour easily recognizable. It is hoped, however, that examination of the clinical and histological features combined with the follow-up in a large number of cases will render their nature clear and enable us to give prognosis.—SCARFF, R. W., and THOMPSON, A. D. (1958), *Brit. J. Surg.*, **45**, 512.

### The Polymerization of Self-curing Acrylics under Air-pressure

Tests were carried out on various brands of acrylic resins to determine if there was any advantage in processing them under increased air-pressure. Clear material was used, as it was easier to compare clarity of porosity, and the manufacturers' directions were followed.

Of 2 specimens of each sample tested 1 was allowed to harden normally in the atmosphere and the other subjected to a pressure of 30–35 lb. per sq. in. When the first specimen had hardened in the atmosphere the one in the pressure chamber was removed and examined also.

The results of the test were that of the 5 samples tested, 4 failed to harden properly under increased air-pressure. On standing in air the materials hardened but became more porous than when first removed from the chamber.

It was concluded that there is no advantage in using an air-pressure chamber for the processing of cold curing acrylic material as the porosity is not reduced or the strength enhanced; furthermore, increased air-pressure causes a marked discoloration of the material. —ATKINSON, H. F., and HARCOURT, J. K. (1958), *Aust. dent. J.*, **3**, 183.